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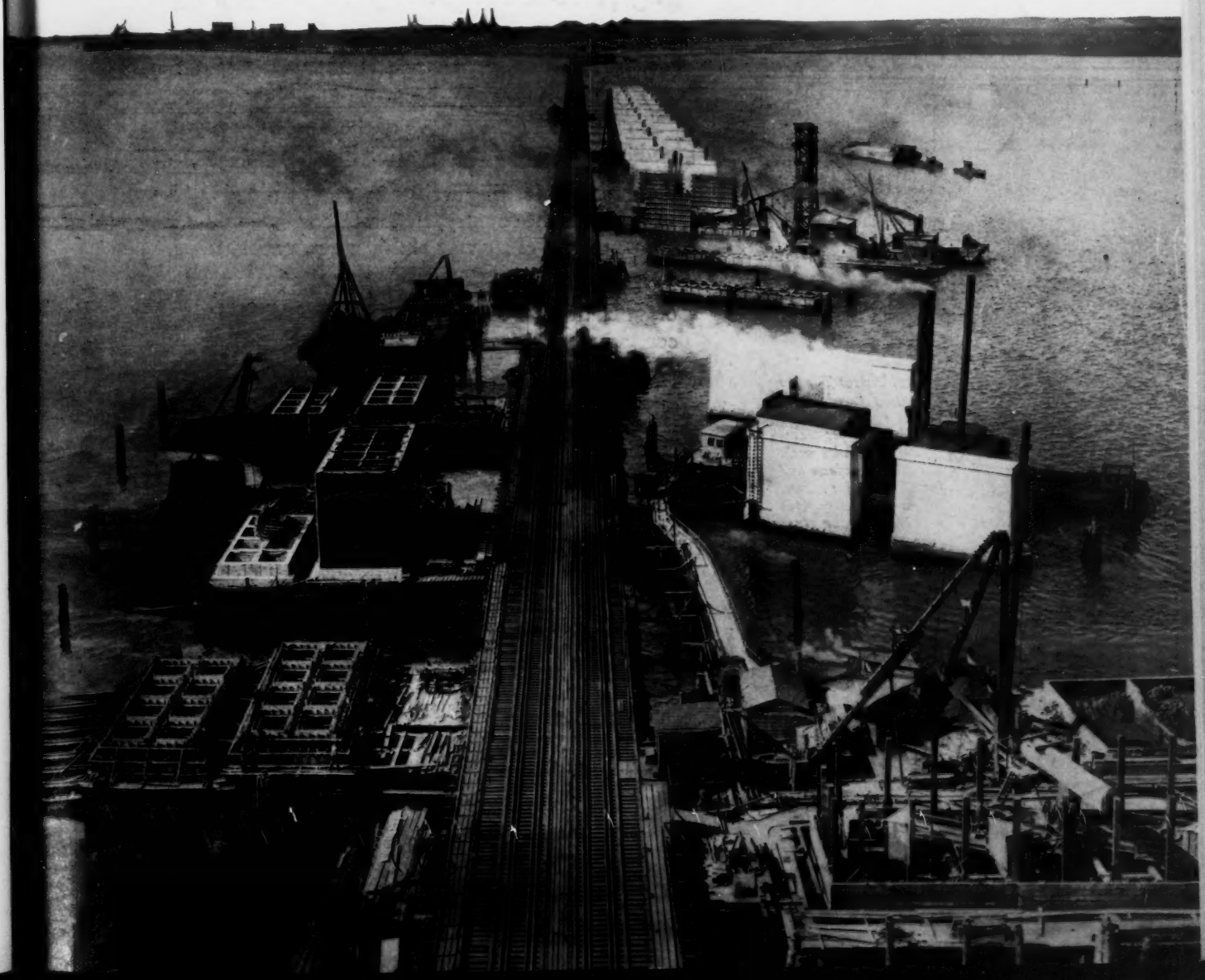
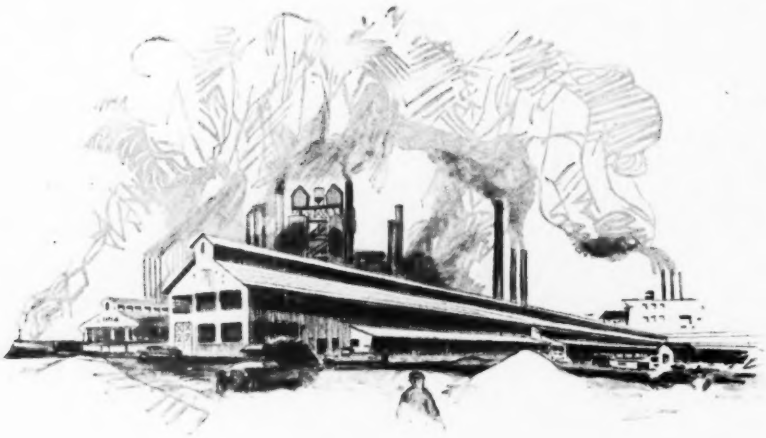
Building a Four-Track Steel Bridge over Newark Bay — Hugh Reservoir and Pumping Plant for London Water Supply — Highway Development in South Atlantic and Gulf States: Louisiana — 210-foot Airship Mooring Tower at Detroit — Report of the Associated General Contractors of America: Annual Meeting at Portland, Oregon

Old and New Central Railway of New Jersey Bridges over Newark Bay





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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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Leonard Metcalf

A GREAT gap has been made in the leaders of the engineering profession. Leonard Metcalf filled a large place there, particularly in the water-works and utility valuation and rate making fields. In the professional societies and in the business and civic life of Boston and Concord he was a great force. Seldom have ability, integrity, professional and public service and a rarely sweet and unshakable friendliness been so richly combined. All this was made to stand out in even bolder relief in the year or more during which he faced certain death, working up to the limits of his diminishing strength and giving out cheerful friendship to those privileged to see him until there came the only possible relief from a terrible malady.

Floods and Forests Again

IN AN otherwise excellent article in the February *Harpers* on the rather hopeless problem of keeping the services and comforts of the city in pace with the ever-growing urban trend of population, Lewis Mumford, an architectural writer of reputation, is guilty of perpetuating a familiar error. In commenting upon the comparability of the flood of population and a river flood rush down the valley and flow over the dikes; and then Ohio used to protect themselves from spring floods by raising dikes; presently, a great tide of water would rush down the valley and flow over the dikes; and the more elaborate ones would be built. As long as cities attempted river control by this sort of patchwork they were perpetually defeated. Genuine flood-prevention dates from the time the flood-prevention engineers planted forests in the hills to retain the moisture and hold back the waters; when they dealt with causes rather than effects." Would that flood prevention were so simple in theory or that the putative solution had succeeded so admirably. But these same "flood-prevention engineers" know how slender a reed to rely on is the absorptive ability of the forest and they know further that it has never been tried on the Ohio, or anywhere else, to any degree that warrants such a wholesale statement. This hoary fallacy has always been popular among the uninformed; it will gain a new lease of life from this pseudo authoritative and widely circulated repetition.

Manner or Matter

THERE are times when one is tempted to believe that parliamentary law is the curse of the American people. With full appreciation of the importance of this heritage of orderly procedure to the English speaking race one cannot avoid railing occasionally at the complications and waste of time that this craze for parliamentary organization entails. Hardly can three or more men get together without proceeding to the writing of a constitution and by-laws, on the details of which no two men can agree and to the formulation of which goes all the dignity that surrounded the drafting of the federal Constitution. And the laudable effort of the presiding officer to learn the will of the assemblage leads to a multiplication of debate, not on the question itself but upon procedure, that would not be amiss in the Senate of the United States preparing to declare war. One longs then for some such Lincolnian gesture as the one when opposing a unanimous proposal of his cabinet the President announced that "the vote stands seven ayes and one nay; the nays seem to have it, the nays have it and it is so ordered." Parliamentary procedure is all right, but like most things one can get too much of it.

The Throttled Suburb

AS A result of an elaborate study of present traffic movement and future traffic needs the North Jersey Transit Commission has prepared a cumulative plan of transit relief for the rapidly growing and poorly served section of New Jersey within the metropolitan district of New York. It contains some 83 miles of new railroad, mostly in tunnel, requires a reformation of the present travel habits of a couple of million of people and will cost complete close to four hundred million dollars. And if or when it is completed its major accomplishment will be to put most of the business section of Manhattan Island within 30 to 50 minutes of a new transfer station in the Jersey Meadows, which itself is another 30 to 50 minutes away from the homes of the Jerseyites who want to get to and from New York daily. No more illuminating commentary could be made on the hopelessness of attempting to cure the evils of urban overdevelopment. The plan of the commission is not beyond criticism. It seems to be more than necessarily obsessed with the notion that existing traffic routes should continue, forgetting perhaps that downtown New York office people have sought New Jersey as a home because of its convenience and that possibly the Manhattan office center is moving northward and westward. The plan, therefore, favors the downtown and eastward section of Manhattan and forces those seeking other sections of the island to a doubling of their travel, both north and south and across town. The commission, too, may not be right in its metropolitan assumption that a through trip, though it be a long and frequent stopping subway ride, is to be preferred to much shorter ferry and surface car trips with forced changes or to the change required for shorter and more direct subways fingering from a common center. But these are criticisms that need more than casual reference to explain. The important fact of the report is that these experts, after a year or more

of study, have not been able to propose any scheme for getting the New Jersey resident his 10 to 20 miles to New York short of an hour and a half of mixed riding in train and subway—the former direct, speedy and comfortable, the latter tortuous, slow and stuffy. The future of the suburb, if this is its future, is none too rosy.

A Departure in Foundations

CONDITIONS virtually unique in bridge history characterize the new Newark Bay crossing of the Central R.R. of New Jersey, whose general plan and foundation work are described in this issue. These conditions made duplication and economy in design of the individual parts a matter of commanding importance. With the great number of spans required, savings small enough to be negligible in the ordinary case claim consideration, and the savings possible in systematic and repetitive construction had to be weighed even against apparent increase of design cost. As concerns the superstructure, the result is expressed in the 300 odd plate girders, of length and weight approaching what is ordinarily considered the feasible limit of size for this type of carrying member, yet plainly the best form of construction for the purpose in hand. In the pier construction, the problem was presented in even more perplexing form, in view of the depth of water, the character of the subsoil, and the variety of available solutions. The remarkable and highly economical foundation scheme evolved by the bridge engineer to meet these conditions is probably the greatest application of the floating-cofferdam system ever made. In general form it follows old precedent, but it is made virtually a new type by the distinctive feature of the reinforced-concrete bottom used in place of the conventional timber grillage as cofferdam floor. The system is not only of intrinsic economy, but favored duplication methods in construction. The smooth execution of the work, especially in such large-scale application, is the best proof that the type merits careful consideration in foundation work wherever the nature of the subsoil permits of founding on piles at moderate depths below water.

Economic Importance of Bridges

ONE of the most notable items of information connected with the Newark Bay bridge work is the huge cost of the new structure as compared with the cost of the first trestle. It is a revelation to observe that even if the reported cost of the old trestle be doubled, to represent the equivalent for four tracks, the new bridge nevertheless cost twenty-five times as much as its predecessor of 60 or more years ago. With such a ratio of increase, the importance of the bridge in a modern railway—or even highway—system is seen to be incomparably more important and critical than in in former times. Looking at the matter in another way, when a bridge, though it be in a four-track, heavy-traffic main line, costs $15,000,000 for a 1½-mile crossing over shallow estuary waters, the controlling relation of the bridge to the remainder of the system is undeniable. A fact worth note is that much of the increased bridge cost, here as well as elsewhere, is due to operating requirements which call for elaborate grade separations in the approaches, and drawbridge operating and signal systems of extreme intricacy and cost. The large investment in such a structure, which, of course, is justified only by lowered maintenance cost and therefore a high degree of permanence of the structure, defines the bridge as a long-time controlling feature in the location and operation of the line. The more important, then, become the studies preliminary to bridge location or renewal, if later economic difficulties and losses are to be avoided.

A Friendly Warning

IN SPITE of the fact that it was held far west of the center of population of the membership the annual meeting of the Associated General Contractors at Portland was well attended and, what is more important, the attendance was interested and, those of it who spoke, interesting. Ample evidence was given that the association is alive and that its members are benefiting from its activities. It is significant, however, that those activities which were given most prominence both in the meeting and in the publicity of the meeting were on matters external to the contractor. Numerous committees relating to the internal activity and business of the contractor are at work in the association and reported at Portland. Such subjects as ethics, labor, construction development, methods of transportation, building and safety codes, equipment and materials—all dealing with the business and technique of contracting—were discussed by committees. But the high spots in the convention were found in the external subjects—surety bonding and day labor construction.

This might be taken to show that the organized contractors are more concerned about the way the world treats them than they are about the way they treat the world, their clients, their employees and each other. That would hardly be fair, however, for the association is doing a great deal toward the reformation of business technique, however little it may be concerned at present with the actual technique of building. But, the contractors seem to think, it is equally as important, if not more important, that there be assurance of continued business for contractors than that the methods of carrying on that business be improved. Hence the drive against day labor construction and the practices of surety bonding, the abuses in which do lead either to less work for contractors or to a lowered profit.

This is excellent effort, if not carried too far. In the excesses of day labor work and in many of the practices of the surety companies the contractors have ample basis for their charges that present conditions are leading to excessive costs of construction, which in the end the people pay. But the contractors will do well to remember that the reforms they propose also benefit themselves, that altruism is not conceded to be a very prevalent virtue among associations, either professional or trade, and that too much public protest, the favorable reaction to which benefits the protestant, sooner or later fails of public approval. Certainly any such protest must be based on incontrovertible facts and be restrained rather than perfervid, for a suspicious public is always looking for that self interest which has been more than anything else the source of the evil connotation that now attaches to the word "propaganda."

So far the A. G. C. in its campaign against the evils of surety bonding has not grievously sinned against this principle. Further than that it is acting co-ordinately with a number of other interests that feel that

surety bonding is in need of reform and with the active concern of the sureties, which are quick to point out errors in the contractors' representations. A live opposition is necessary in any campaign for reform just as it is in the conduct of a government. But in the day labor fight the A. G. C. has no organized opposition and it has been led, by that fact possibly, to occasional assertion and exaggeration, which, not being controverted, it is apt to assume to be incontrovertible.

No one can quarrel with the association for its enthusiastic effort to better the business of its members, and incidentally to make the construction dollar worth more to the user. But merely as a strategical move agitation for reform must finally be based on documented examples of the evil to be reformed and not on general denunciation. So far in its day labor campaign the A. G. C. is somewhat short of convincing in this necessary specification.

Will the Inland Waterway Come Back

COMMENT has frequently been made on the curious psychology that surrounds the popular demand for waterway transportation. There are experts who have studied the question who base their demands for further improvement of our rivers and the digging of canals on rational grounds but they are an insignificant minority compared to the vast body of clamorous citizens who flock to our river and harbor congresses, who hold editorial chairs on our newspapers and who pester our legislators—all demanding more and better waterways as the solution not only of our transportation difficulties but also as a cure for most of our economic ills. These enthusiasts are victims of a complex, whose existence they may not even recognize and whose source they of course do not understand.

This complex may be traced back to several things. It is partly due to the true, though unimportant, observation that vehicles move more easily through water than on land; it is partly a subconscious revolt against the predatory activities of the railroad promoter and operator of a generation ago; it is partly a tribute to the natural as against the artificial; and it is largely, probably, a part of the irrepressible feeling that that which the state, meaning everybody, pays for costs the individual nothing. All of these, it will be recognized, are intangible impulses which are hardly formulated and which certainly will not stand up under the spotlight of facts. Nevertheless they govern the commonality of thought in favor of waterways, and responsible advocates of waterway improvement have always to sit in the same gallery with these psychopathic enthusiasts and take the blame for all their excesses.

That there are genuine waterway proponents goes without saying. A number of transportation experts and engineers who have divorced themselves from historical delusions and psychological disturbances have become persuaded that for certain locations and under certain conditions the river or canal offers an economical prospect for freight transportation. Their advocacy, however, is as a rule for some specific project which they have studied in detail and is based not on the generalities of the waterway enthusiast but on specific conditions in the district and on the waterway they propose. So specious, however, have been the general arguments of the enthusiasts and so discredited has become their propaganda that the expert who would have some specific waterway built has not only to get across his own arguments but first has to overcome the opposition that the waterway boomer has aroused among those who have really studied transportation.

There appear to be, however, a growing number of the really informed who are joining themselves to the waterways movement, if not for the general propaganda at least for some single project. This may be due to two changes that have come in the conditions surrounding waterway transport. These are the growing importance of the motor truck and the acceptance of the necessity for mechanized terminals.

Up until a few years ago it was obvious that the territory contributing to the waterway was limited practically to the grounds lining its banks. Actual carrying charges on the waterway itself were very low so that a factory on a river or canal could deliver to a warehouse somewhere else on the same waterway at a cost ridiculously below a similar cost of transportation by rail. But this tributary area, both for supply and for delivery, was limited to the economic limit of the horse drawn truck, because once the freight had to be loaded on a train, either at factory or receiving dock, the cost of transshipment plus cost of the connecting rail freight laid too great a burden for the lower water rate to bear.

This transshipment burden still exists, but thanks to the motor truck with its extensive economic range of travel, this contributory area beyond the waterway has been so widened as to make feasible many a project which ten years ago would have been impossible. Once the commodity is loaded on the motor truck at factory or farm, that truck can be driven a long way to gain the advantage of lower water-borne rates.

The waterway will never become economically feasible, however, until the terminal problem is solved. This is now appreciated by all those who promote the waterway idea, and to that degree the future of water transportation looks more hopeful, though indeed the theory of terminal need is still far ahead of the practice. Too much reliance in argument is still being placed on the low cost and simple mechanism of the granular handling equipment and too little on the necessities of package and bulk handling and on the details of storage and delivery. But it is recognized that the high cost of water transportation does not lie in the actual getting of the boat from port to port but in loading and unloading that boat and in providing a constant and regular supply of the load.

There still remains the dilemma of not being able to get business unless there are boats and not being able to procure boats unless there is freight offered, though that may be overcome by a period of government operation. There is still the huge cost of construction assumed by the whole people and only imperfectly returned to the people through lower rates passed on to lowered prices. There is still the incontrovertible fact that no inland waterway in this country since railway transportation became effective has ever even approached paying for its real cost unless one wishes to claim a large, and altogether unprovable, benefit through lowered competitive rail rates. Nevertheless there is growing favorable view toward the waterway, mainly because of the two changing factors noted, and the coming decade may well see a revival of what a few years ago was apparently a doomed transportation agent. If the waterway can divest itself of its foolish, but vociferous, friends it may once more take its place in our transportation economy.

Building Four-Track Steel Bridge Over Newark Bay: Two Types of Foundation

A Costly Traffic Improvement—High-Level Crossing of Girder Spans With Two Vertical Lifts Replaces Present Low-Level Trestle With Bascules—Details of Floating Cofferdam and Pneumatic Piers

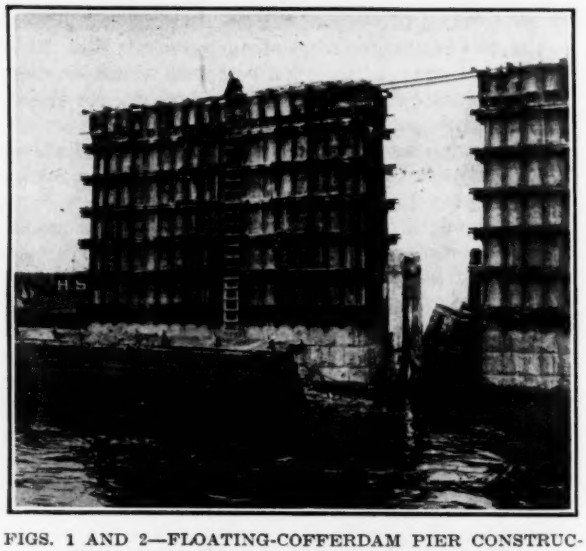
WORKING against many formidable obstacles, the Central Railroad of New Jersey has, during the past two years, built a remarkable new bridge over Newark Bay, a structure 7,411 ft. long and costing nearly $10,000,000, or with its necessary approach improvements and grade-crossing eliminations about $15,000,000. The difficulties which beset the project were partly physical, and partly derived from the relation of the railroad to shipping and local interests. Both influenced the controlling features of the plan as finally worked out. The project embodies numerous features of striking originality both in the foundation and the superstructure work, in methods of execution as well as in design.

While the physical difficulties of the site were not exceptional, the great size and cost of the structure called for unusually careful study to obtain maximum efficiency and economy. These results were realized in notable degree. The present article presents in brief form a statement of the general development of the project and a description of the foundation work, a later article will deal with the steel superstructure.

Prior Conditions—Seven miles west of its New York terminal at Communipaw, the Central Railroad of New Jersey crosses Newark Bay close to its mouth at the Kill von Kull. At this point open water is nearly 2 miles wide. The bay receives the discharge of the Hackensack and Passaic Rivers some miles above, but its depth of about 20 ft. on the average is maintained more by the strong tidal currents sweeping in and out of the bay than by the river flow. Shipping movement here has steadily increased in recent years; the large number of vessel movements through the bridge, coupled with the strong current and winter ice troubles, were essential factors in the necessity of building the new crossing and doing away with the timber trestle on which the railroad has crossed the bay at this point for sixty years.

In 1863 the railroad, which previously had its eastern terminus at Elizabethport, on the west bank of the bay, built a double-track pile trestle 9,741 ft. long across the bay with a cast-iron swing span designed and built by Lowthorp, of Trenton, which gave two 75-ft. openings across the then 10-ft. channel. The entire structure—trestle and draw, with fenders, etc.—cost only $327,653, a sum which compares interestingly with the cost of the bridge now being completed. Later, the draw was twice replaced, in 1888 by a through pin-connected wrought-iron truss bridge, and in 1905 by two Scherzer rolling-lift bascules placed back to back and giving two 85-ft. openings at the channel, which by this time had been deepened to 30 ft. The trestle was continuously maintained, though the original white pine piles and deck were progressively replaced by creosoted material and heavier deck construction.

Both railway and shipping traffic steadily increased, the shipping multiplying fivefold in number of boats and even more in tonnage during twenty years. In 1924 the two bascules made 21,000 openings, and passed 46,000 vessels. As there are no closed hours for shipping at this point, railroad traffic has been much inconvenienced. In winter the close-piled trestle construction tended to cause ice jams which interfered with navigation. The railroad now operates nearly 300 scheduled passenger trains per day in addition to its freight traffic. The business long since has outgrown the two tracks which the old structure provided (a short length at the east end had been widened to three tracks). These several factors combined led the railroad management to conclude a number of years ago that a new crossing, of four tracks, should be built as early as possible. A new right-of-way just upstream of the existing trestle was acquired for the purpose.



FIGS. 1 AND 2—FLOATING-COFFERDAM PIER CONSTRUCTION, NEWARK BAY BRIDGE, CENTRAL OF NEW JERSEY

Above—Launching of floating cofferdam built up of reinforced-concrete bottom slab and removable timber sides. Below—Removing side walls of cofferdam after building pier.

Negotiations preliminary to final development of the plans extended over a period of about six years. They were marked by many contests with the state of New Jersey, navigation interests, and local communities. The principal opposition came from the city of Newark, which sought to have a bridge at this point eliminated in the interests of its shipping terminal on Newark Bay above the bridge site. The state's Board of Commerce and Navigation upheld the Newark demand that the bridge should be replaced by a tunnel or else the location shifted to the upper end of the bay. However, the railroad acting under its original state charter for the crossing had obtained the passage of an enabling act by Congress to authorize construction of the new bridge, and had obtained the War Department's approval of its plans as being satisfactory from the navigation viewpoint. A federal court suit to enjoin construction of the bridge was decided in favor of the railroad in all stages, the suit being carried up to the Supreme Court. The final decision was similar to that in the Castleton bridge case of the New York Central R.R., holding that the federal jurisdiction over navigation interests in navigable waters is complete and exclusive, and the state, having acted in its original charter grant, has no present ground for protest.

General Design—Two controlling considerations as to the new bridge were to build it with sufficient vertical clearance above water to permit all low vessels to pass through without opening the draws, and to eliminate trestle construction in favor of span construction, so as to permit passage of small vessels and prevent or minimize ice jamming. These and other considerations, together with stipulations by the War Department, fixed the following elements of the structure: Two independent channel openings of 200 ft. and 125 ft. respectively; channel openings in line with the channels and currents, this being at an angle of 59 deg. 11 min. with the axis of the bridge and therefore making the draw spans 305 ft. and 216½ ft. long respectively; underclearance at mean high water 35 ft. at the draw spans with draws closed, and 135 ft. with draws open; piers of fixed spans 125 ft. c. to c., and set parallel to the direction of the channel; provision for future channel depth of 40 ft.; water depth under the fixed spans 20 ft. below mean low water.

The crossing as planned on the basis of these requirements is of straight alignment and for almost the full length on level grade. It consists of an east approach viaduct of 30 and 60-ft. to 35 and 70-ft. plate-girder spans, a main plate-girder bridge of 41 spans generally 124½ ft. long, all of four-track construction; and two sets of twin double-track vertical-lift spans with flanking truss spans, giving four-track crossings over the two channels, respectively 305 ft. and 216½ ft. long c. to c. piers. In both cases the lift towers are set on the adjoining truss spans.

The foundations for these spans are of two different types. The piers for the lift spans, because of the great size of these spans—the 305-ft. spans are the heaviest movable spans in the world—were carried to rock, which is at a depth of 50 to 70 ft. rather uniformly across the entire width of the crossing. The other piers, however, could be founded on piles driven into the hard clay and gravel strata overlying the rock, in view of the shallower depth of water specified here. The piers supporting the plate girders, therefore, are founded on piles cut off at El. —22.3.

All piers were designed of concrete with a granite belt course 8 ft. deep in the tide range (mean height of tides is 3½ ft., extreme height about 11 ft.).

The great number of fixed spans, with eight girders per span, required a total of 328 plate girders, of which 288 are precise duplicates. This huge duplication work imposed extreme requirements on the designers in securing the maximum of economy in design, both as to material used and as to shop work and other factors of construction. These girders are 10 ft. 8 in. deep and weigh 54 tons each.

Twin-Line Construction—Considerations of weight and feasible size of floorbeams and operating mechanism made it desirable to design the lift spans as two parallel double-track spans with separate counterweights and machinery. The spread of the tracks resulting from this arrangement and the desirability of keeping the track alignment straight throughout, led to similar twin construction of the plate-girder spans, so that as a whole the structure may be said to consist of two parallel double-track crossings. The piers supporting the plate-girder spans are similarly of twin construction, each double-track line having its own piers; but the pneumatic caisson piers carrying the lift spans worked out more conveniently as single structures extending across the full four-track width.

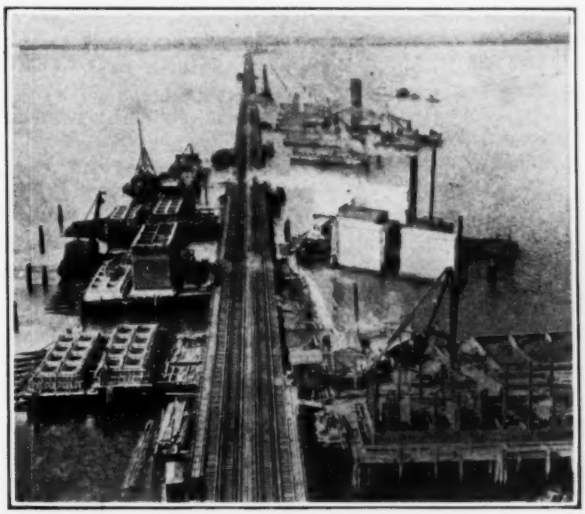


FIG. 3—SUBSTRUCTURE WORK FOR NEWARK BAY BRIDGE

Foundations—Careful study was given to the types of foundation suitable for the fixed spans. Any economy of design that could be secured here would amount to large totals, in view of the great number of piers to be built. As the soil below the required dredging level of 20 ft. was practically everywhere firm, consisting of sand, gravel and hard clay strata, it was evident that piles driven to rock would give a thoroughly dependable and cheap method of support. Accordingly, the floating-cofferdam method of pier construction was worked out as the most rapid, economical and secure against unforeseen difficulties.

In place of the conventional timber grillage bottom, a reinforced-concrete bottom was designed for the floating cofferdams. The details of this bottom and of the removable sides were so worked out as to simplify and facilitate in every way the construction, launching, sinking, and subsequent dismantling of the cofferdams.

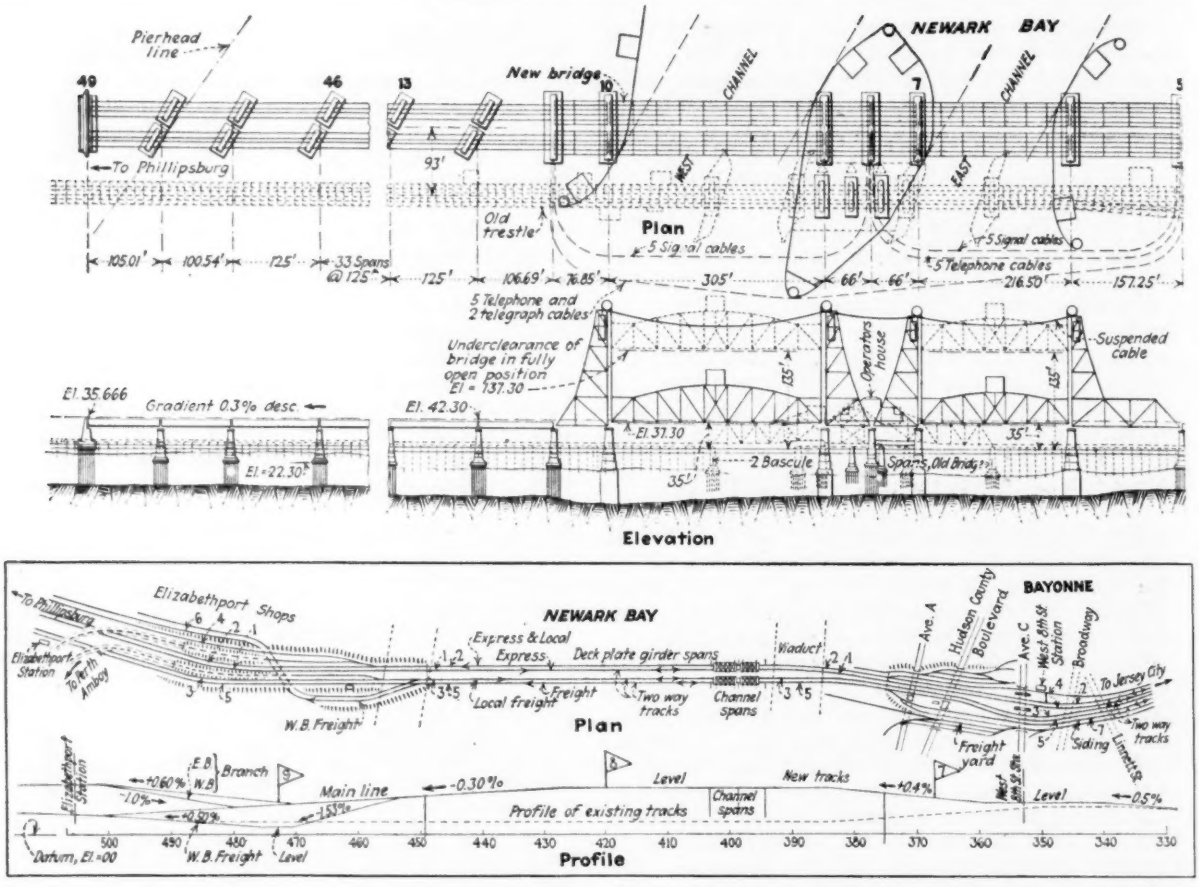
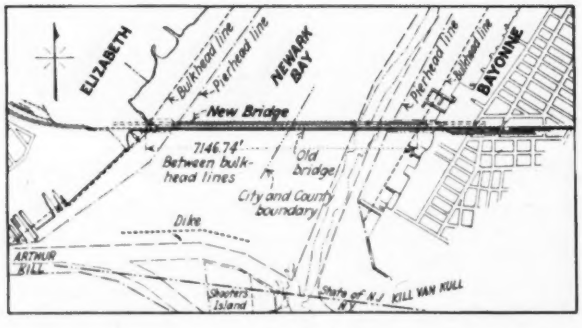


FIG. 4—GENERAL ELEVATION, LOCATION AND TRACKAGE

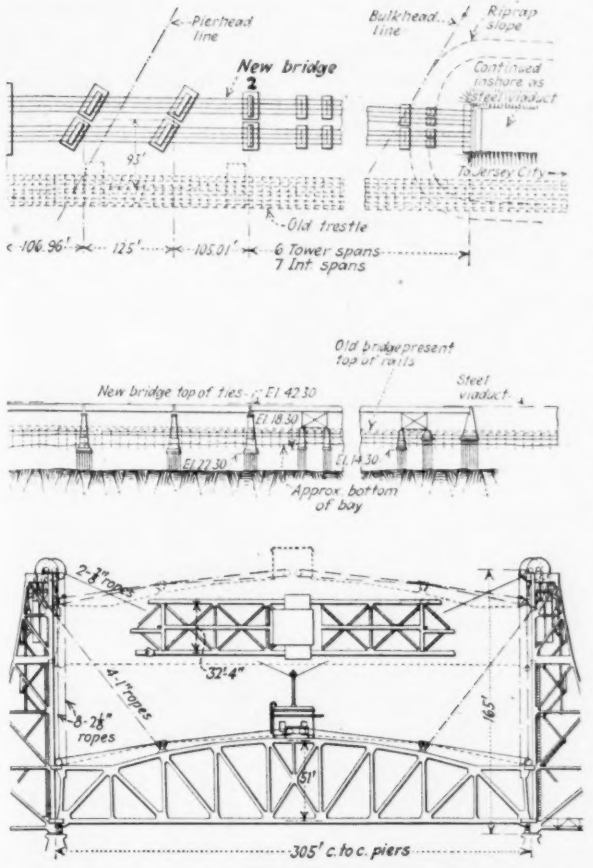


Drawings of a completed pier and of the 25x50-ft. floating cofferdams are shown in Fig. 6. The reinforced-concrete bottom was cast on a cradle on launching ways near the work, and was prepared for launching after seasoning for 21 days. The six side sections and two ends were then set in place and thoroughly calked along the base and their vertical joints, and the completed cofferdam was then launched (Fig. 1). At the site of the pier to be constructed, piles had been driven and cut off by this time, and the cofferdam was sunk to place on the piles. The pier was built inside the cofferdam, and was usually carried to completion before the sides were removed. The latter operation required merely removing the bolts between the sections, turning the long hookbolts passing down through the sides which held the side sections to the base, and floating the sections away separately.

One of the advantages of this design and system of construction, besides its rapidity, was the economy obtained from using the cofferdam sides over again repeatedly. In some cases the side sections were used over as many as twelve times and could have been used several more times if the speed of construction had permitted.

Pneumatic Piers—The draw piers, alongside the channels, were of the pneumatic type, as already stated. The depth of water (required channel depth 40 ft.) and the heavy superstructure loads made a pile foundation impracticable or at least very difficult, while pneumatic caissons could easily be sunk to rock (here found at depths of 57 to 72 ft. below low water). The size of pier necessitated by the superstructure requirements, on the other hand, made it inconvenient to attempt to build separate piers side by side for the two double-track structures, as decided upon for the piers of the fixed spans, while on the other hand the size of a single caisson pier carrying both of the spans did not exceed practicable and convenient dimensions for caisson construction. A single pier caisson was designed accordingly, with a size of 25x100 ft. Steel working chamber with wooden caisson superstructure was decided upon. This made it possible to have the caissons built on the shipways of the Federal Shipbuilding Co., at the upper end of Newark Bay.

The caissons (see Fig. 6 for drawing of caissons and piers) were built on their sides. This unique method was resorted to by the shipbuilding company because the narrow proportions of the caissons (requiring deep trim for stability at launching) and the water depth available in front of the launching ways made upright



PLAN, C. R. R. OF N. J. CROSSING OVER NEWARK BAY

construction impracticable. The sides of the caissons were built up before launching to about 40 ft. height, the full height of the permanent caisson shell. The caisson shafts being bulkheaded off, the caisson was launched, coming to an inclined trim, the steel working chamber riding lower in the water than the wooden superstructure. In this condition the caisson was towed to the shipbuilding company's dry dock, and there was righted by derrick, placed in dry dock and ballasted by depositing concrete in the wedge-shaped spaces inside the cutting edges, giving the caisson a draft of about 18 ft. and sufficient stability to enable it to be floated to the pier site in upright position. Here it was settled to the bottom by adding concrete, and was then sunk to rock under compressed air, which work proceeded without special incident. Pressures up to 35 lb. were used through the clay, gravel and sand strata. Much of the excavating was done with air shovels—shovel blades set into the sockets of pneumatic hammers—for cutting into the hard soil.

Rock bottom was found fairly level and smooth. The material is a gray sandstone so sound as to require practically no excavation of softened portions. Of the four caissons, only one encountered a decided slope or irregularity of the rock surface, and here, to avoid the expense of much rock excavation, the caisson was stopped when about one-eighth the length of the cutting edge was still above rock, and the remaining excavation was carried down to rock under cover of sheeting.

The heavy tidal currents at the pier site, often exceeding 4 miles per hour, made it necessary to guide and anchor the caissons carefully when settling them to the bottom and in the early stages of sinking; no other difficulties of note were encountered in the work. The caisson shells were concreted and pier construction begun as the caissons were sunk; a temporary cofferdam built on top of the permanent caisson shell protected the pier work until well above high water level.

Foundation Construction—Two main contracts were let for the foundation work: Construction of the fixed piers to Henry Steers, Inc., and of the pneumatic piers to Arthur McMullen Co., both of New York. A separate contract was let for the dredging, to the Atlantic, Gulf & Pacific Co., whose work involved 475,000 cu.yd. of hydraulic dredging, the material being pumped to the west approach and used on the approach embankment.

The construction plan for the substructure involved dredging a trench across the bay for the full length of the bridge, wide enough for the twin piers, to a depth of 23 ft. below low water, and in addition a 200-ft. channel along the north side of the site of the new bridge for the floating construction plant. In this dredged trench the piles were driven and cut off, and the piers built.

The dredging was done by a suction dredge with 7-ft. cutter and 29-in. suction pipe, discharging through a 27-in. pipe. The maximum delivery distance was 5,400 ft., and material was delivered to a maximum height of 23 ft. above water level. The final building up of the approach embankment was done with draglines working along the top of the embankment.

Piledriving and Cutting—The foundation piles for the piers of the fixed spans were driven with a McKiernan-

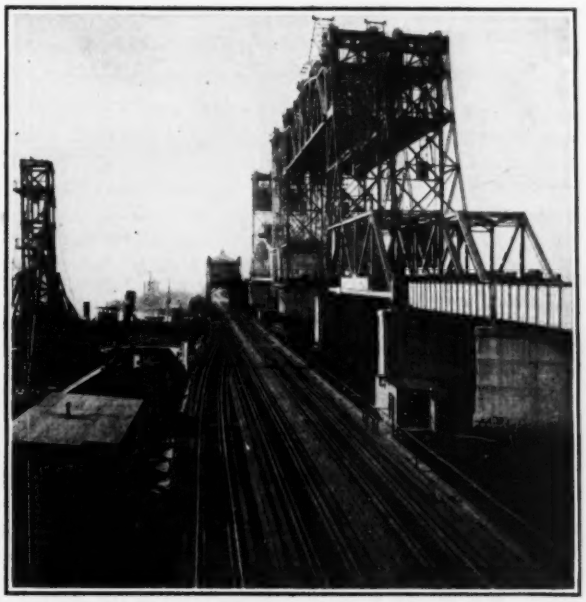


FIG. 5—PLATE GIRDER AND TWIN LIFT SPANS

Terry underwater hammer to about 18 in. above cutoff level. When all the piles for a pier had been driven, they were cut off by a saw barge. This was an 800-ton barge fitted with vertical leads in which a 12-in. H-beam could slide up and down, being handled by a differential hoisting tackle of high multiplication, permitting close control of height to be obtained. The H-beam carried bearings for a 4¾-in. vertical shaft 50 ft. long, bearing a circular saw at its lower end. The barge would start

at one corner of a group of pier piles and work forward across the entire group in successive swaths, under continuous check by a wye-level sighting on a white mark on the saw shaft. The hoisting tackle arrangement, which made 1 ft. movement of the hoisting line correspond to $\frac{1}{8}$-in. change in level of the saw, coupled with the instrumental supervision, made it possible to get very close results in this sawing. The maximum variation of level of the piles in a group did not exceed $\frac{1}{4}$ in.

Building and Sinking the Floating Caissons—For the construction of the floating-caisson bottoms, a launching platform was built on piles alongside the old trestle bridge, affording sufficient space for concreting six caisson bottoms. On these platforms inclined ways

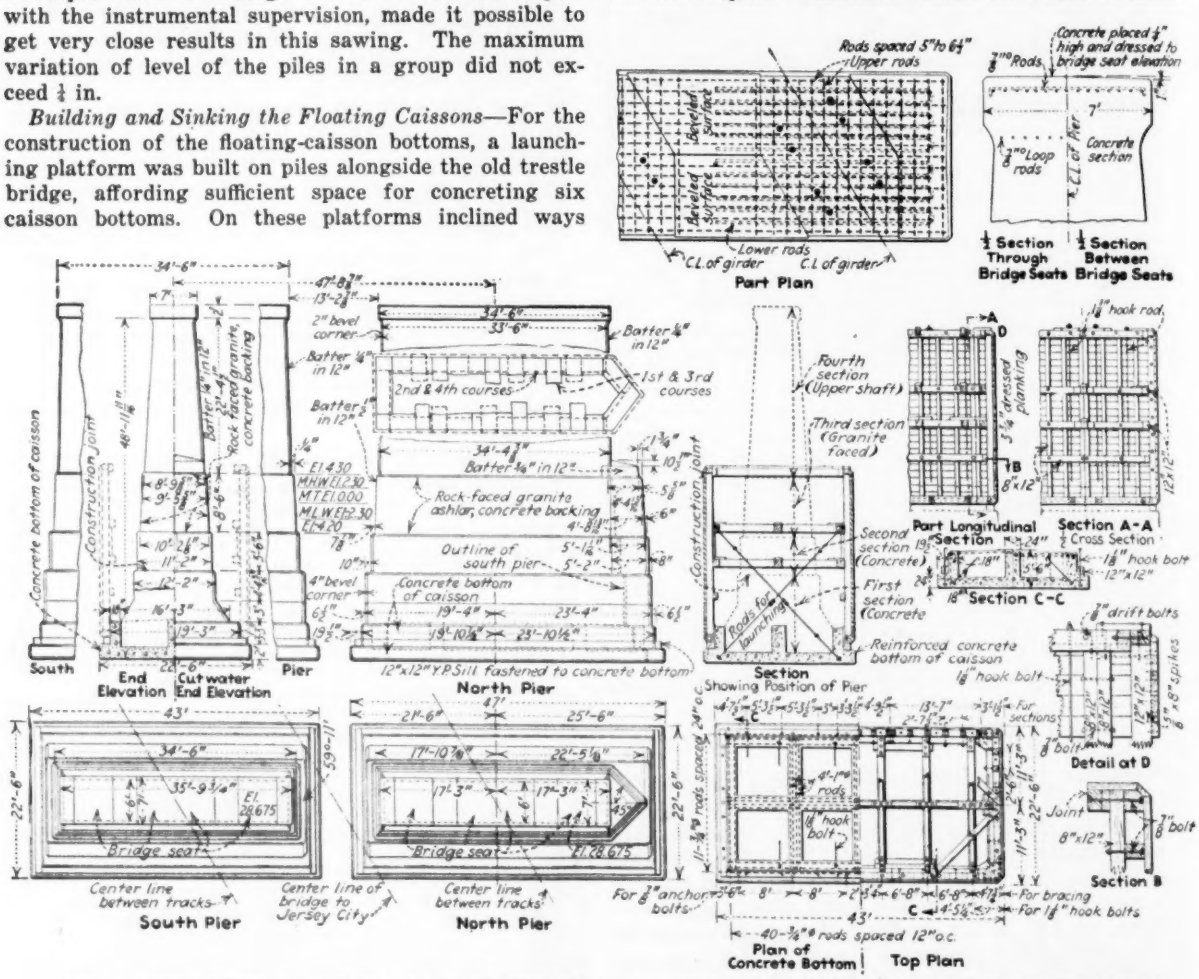


FIG. 6—TWIN PIERS OF 125-FT. PLATE-GIRDER SPANS, AND FLOATING COFFERDAM USED IN CONSTRUCTION

were built, the caisson bottoms being supported on cradles on these ways. The first one was built on the slope of the ways, but as the workmen found difficulty in adjusting themselves to working to the inclination the remaining ones were built level and plumb.

The bottoms were designed with reinforcement sufficient for the launching stresses. The bottom slab as designed was 18 in. thick. With this thickness, and the heavy massing of reinforcement at some points, difficulty was experienced in two cases in getting a wholly watertight bottom; after sinking, the bottoms developed leaks at a few points, especially where thorough working of the concrete during construction was difficult. After this experience, the bottom thickness was increased to 24 in. and the fineness modulus of the aggregate for the mix in the cofferdam bottom was reduced from 5.7 to 5.6. No further leakage developed in the remaining cofferdam work.

Supervision of Concrete Work—Durability of the substructure concrete was a primary objective. It was also desired to take full advantage of the results in efficiency, economy and uniformity of concrete work that could be obtained through careful control of mixture and water ratio. Previous concrete work of the Central Railroad of New Jersey in which these control methods were applied had shown satisfactory results in this respect. Excellent results had been obtained as early as 1917 in concrete substructure work for two bridges, with a slump of less than 3 in., using a coarse grade of sand.

With a view to applying this experience to the construction of the Newark Bay bridge, the specifications called for concrete mixtures in which the ratio of cement to sum of separate volumes of aggregate was fixed (1:6 for the pier bodies, 1:5 for the reinforced cofferdam bases and the bridge seats), and provision was made for determining the fineness of each lot of aggregate and fixing the proportions of fine and coarse aggregate accordingly. The fine aggregate was required to pass 95 per cent through a No. 4 sieve and not more than 30 per cent through a No. 50 sieve, with a maximum silt percentage of 3 per cent, in addition to which there were provisions covering the shape and hardness of grain, organic matter, and the strength of sand-mortar briquets (equal to briquets of Ottawa standard sand and mortar). The stone sizes were specified as not more than 95 per cent passing the 3-in. sieve, 40 to 75 per cent passing 1½-in., 15 per cent

passing No. 4, and 5 per cent passing No. 8, in the case of mass concrete; and not more than 95 per cent passing 1½-in., 40 to 75 per cent passing ¾-in., 15 per cent passing No. 4, and 5 per cent passing No. 8, in the case of reinforced-concrete aggregate. Under this specification sand and gravel were obtained from a screening plant, the various sizes from which were then combined as follows: For sand: ¼ coarse grit (⅛ to ¼ in.), ¼ fine grits (No. 14 mesh to ¼ in.), ½ building sand (below No. 14 mesh). For coarse aggregate:

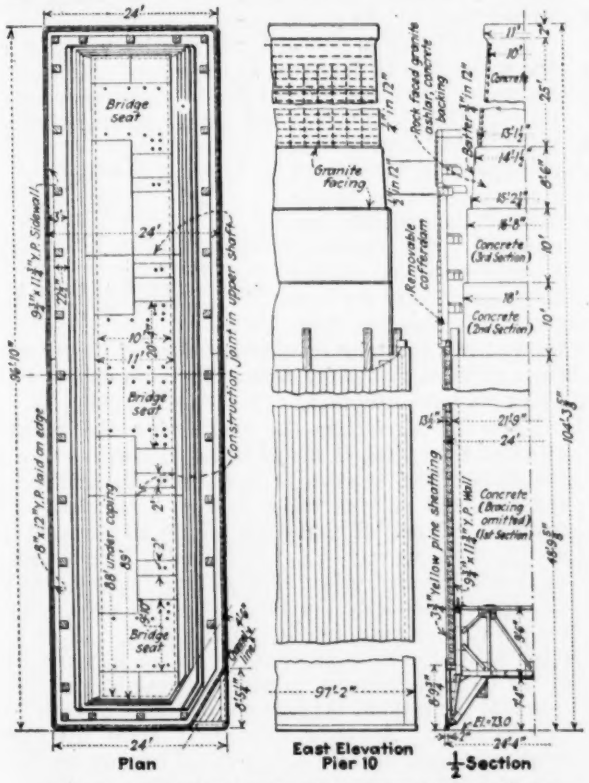


FIG. 7—LIFT-SPAN PIER AND PNEUMATIC CAISSON

20 to 25 per cent of ⅜ in., 30 to 25 per cent of ⅜ in., 30 to 25 per cent of ¾ in., and 20 to 25 per cent of 1½-in. pebbles. The fineness modulus of each scowload of material was determined on several samples, and the proportioning adjusted to the fineness modulus of 5.7 (except that for the bottoms of the floating cofferdams 5.6 was finally adopted).

Each mixing plant was equipped with a Blaw-Knox batcher. The proportions required by the sand and gravel delivered during the larger part of the work were 5 cu.ft. of cement, 12 cu.ft. sand, and 18 cu.ft. pebbles or 1:2.4:3.6.

Moisture content was controlled by slump. In the early stages of the work the slump ranged from 1½ in. to 6 in., but later, with more experience in the field, it could be held between 1½ in. and 3 in. Water was measured by tank fitted with gage glass.

One-yard mixers were used in the three mixing plants. The time of mix throughout was 1½ min.

Generally, chutes were used for distributing the concrete within the cofferdams (in the case of the floating-cofferdam piers). The slope of the chutes was 1 on 3 to 1 on 2.8. At first some difficulty was experienced in getting the concrete to flow freely down the chutes, but when it was noted that clogging occurred only after a batch had been held in the bucket or hopper, the operating system was changed so that whenever a batch had to be held for a few minutes it was held in the mixer rather than in bucket or hopper. With this change, and the precaution of cleaning the mixer, chutes and spouts thoroughly at the beginning and end of each run, chuting troubles disappeared.

In the pier work the concrete was discharged at the bottom of the chute into a conical spout, and the end of this was kept within a few inches of the deposited concrete to prevent segregation. In the forms the concrete was thoroughly worked with long-handled narrow spades and with wooden paddles. Excellent surfaces were secured, and according to all the evidence the entire mass of the concrete work is dense and sound. Compression tests of the concrete, made on 6x12-in. cylinder specimens molded from the concrete as delivered from the mixer, showed an average of 3,150 lb. for the 1:6 concrete and 3,800 lb. for the 1:5 concrete, at 28 days.

Quantities—Some of the principal quantities involved in the substructure work of the Newark Bay bridge are as follows:

Dredging, 750,000 cu.yd.
Fill, 2,000,000 cu.yd.
Floating-cofferdam piers, 86—24½ ft. x 43 to 47 ft.
Pneumatic piers, 4, 25 ft. x 100 ft.
Piles, number, 15,650.
Timber, 3,200,000 ft.b.m.
Concrete, 90,000 cu.yd.
Granite, 7,700 cu.yd.
Steel reinforcement, 1,100,000 lb.
Cost of foundations, $3,000,000.

Organization—The work was designed and carried out under the direction of the engineering department of the Central Railroad Company of New Jersey, A. E. Owen, chief engineer; J. J. Yates, bridge engineer; A. M. Zabriskie, principal assistant engineer, and H. E. Van Ness, construction engineer. Dr. J. A. L. Waddell was retained as consulting engineer on the superstructure of the vertical-lift spans.

Traveling Crane With Underhung Hoist

An overhead traveling crane of a type unusual in this country, but used to a considerable extent in English freight houses and dock sheds, has been built for the dock shed of the Uganda Ry. at Kilindini, East Africa. On the crane bridge of 42-ft. span travels a shallow carriage or trolley from which is suspended a revolving cage equipped with hoisting apparatus and a boom. When the trolley is at either end of its travel, the boom extends nearly 15 ft. into the adjacent bay, so that the operation of the crane is not limited to the bay in which it travels. From floor to runway rails the height is 16 ft., while the clear headroom under the revolving hoist is about 9½ ft. The working radius of the boom is from 20 ft. to a minimum of 17 ft. when the boom is raised by its topping lift. This crane has speeds of 200 ft. per minute for longitudinal travel, 100 ft. for traversing the trolley, 150 ft. for hoisting, 125 ft. for swinging and 50 ft. per minute for lifting or luffing the boom.

Temperature Deformations in Concrete Arches

Crown Deflections Give Basis for Direct Method of Determining Temperature Effects by Simple Calculation

By Hardy Cross
Professor of Structural Engineering, University of Illinois, Urbana

BECAUSE of their beauty, rigidity and economy, masonry arches are of peculiar interest and importance to bridge engineers. The mathematical theory of their design is today adequate to work from any set of assumptions as to physical conditions, and the attention of investigators is centered on the study of the latter. Such studies involve questions of the effect of spandrel walls, spandrel posts and floor panels on the action of the arch rib, uncertainties as to the deformations produced by stress, arising from variations in the value of E as ordinarily understood and from plastic flow, ignorance as to the distortions of foundation beds, and inadequate data as to internal distortions produced by shrinkage, by moisture, and by temperature changes.

The last of these problems, that of internal distortions due to temperature changes, has engrossed the attention of several investigators and much time and money have been spent on it. The usual method is to study by field measurements the range of internal temperature, to multiply this by the coefficient of expansion of concrete as determined in the laboratory and thus determine the change of span length which would take place in the arch as a free body. From this we can deduce, for an assumed value of modulus of elasticity E, the stresses produced by the end restraint. The uncertainties inherent in the assumed value of E make the precise determination of the free change of span not especially significant, but its approximate determination is important. But this change of span is also affected by shrinkage of the concrete in setting and by variation in moisture content.

Apparently the easiest way to determine this free change of span is by measurements in the field. The vertical movement of the crown bears a definite and determinable relation to the free change of span, it can be accurately measured with a small expenditure of time and money, and it gives the combined effect of all elements, which is what is really wanted. Such measurements are in no way dependent on measurements of the temperature in the air or in the concrete or of the coefficient of expansion of concrete or of the rate of shrinkage.

Crown Deflection—Assume an arch ring *SCS* (Fig. 1). In expansion the crown C will rise to C''. This movement may be considered as made up of two parts, CC' due to the change in rise which would take place were the arch a free body, and $C'C''$ due to the restraint. The ratio of CC' to the change of span which would take place if the arch were a free body is merely the value h/l, or the rise ratio of the arch. It remains then to discuss the accuracy with which it is possible to compute the ratio of $C'C''$ to this free change of span. For simplicity neglect for a time the effect of rib-shortening due to direct compression in the arch ring, and confine attention to the effect of the bending moments on the angle changes or rotations between the ends of the differential lengths of the arch axis.

Each differential rotation (call it $d\phi$) causes a rise or fall of the crown. This $d\phi$ has also caused a change in span length, or rather it has prevented a change in span length. Now, it can be readily shown, either from virtual work or by area moments or by the use of the calculus, that the movement of the crown due to this rotation is the statical moment of $d\phi$ about a vertical through C, and that the change of span length is the statical moment of $d\phi$ about a horizontal line through *SS*. If, then, we can compute the values of $d\phi$ we can determine a ratio for the rise of crown due to these internal rotations to the change of span which would be produced by the same cause.

Really all that is needed is the relative values of $d\phi$, and these may be found in any standard treatment of arches as the values Mds/EI due to a unit temperature thrust. But these values will not be accurate because the values of E vary from point to point in the arch ring and because plastic flow of the concrete has occurred and perhaps because rotation of the abutments has taken place. It remains, then, to be shown that any reasonable values of these variations will not materially affect the value of the ratio which we have computed.

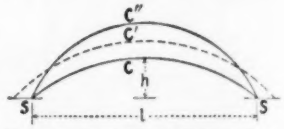


FIG. 1—TEMPERATURE DISTORTION OF ARCH

Effect of Variations—In considering the possible effect of time yield, it should be noted that E above is the ratio of deformation to stress actually existing in the arch and not the value of E as determined in a testing machine. If time yield affects all parts of the arch in the same way—i.e., by decreasing E in the same ratio—the relative values of ds/EI are not affected at all, and consequently the ratio of crown deflection to change of free span length is not altered. If, on the other hand, the ratio of strain to stress is a function of the outer-fiber stress, it will be found in any given case that the ratio of the external distortions is affected only slightly. Analysis of several cases assuming values of E varying from 1 to 3 failed to show an influence of 5 per cent on the ratio of the deformations.

Computations also show that the ratio of crown deflection to span change is altered only about 10 to 15 per cent by changing an arch from hingeless to two-hinged. But in those cases in which the abutments of masonry arches rotate somewhat under stress, they are never even approximately free to rotate, and it may reasonably be supposed that rotation of the abutments will never affect this ratio as much as 10 per cent.

It may, then, be concluded that the ratio of the crown deflection due to temperature changes and similar causes to the change of span which would take place if the arch were free to expand can be computed accurately within 10 per cent, and indeed usually within 5 per cent, if the ends do not spread or settle unequally. Any change of span can be corrected for. Differential settlement of the abutments is improbable and could not be caused by temperature changes.

Crown Deflection as Influence Ordinate—The ratio of $C'C''$ to the free change in span length in Fig. 1 is an influence ordinate for crown thrust due to load at the crown. This is a corollary of the principle of virtual work. In this case it may be most readily proven as follows. Assume that a force P at B is just balanced by forces H and vertical reactions as shown in Fig. 2*a*, and that they are such that no movement

occurs at abutments A or C. Let the deflection of point B be to B'. The total work is $\frac{1}{2}P(BB')$. Now imagine that the H forces were not present at first and that the structure were free to deflect to the shape $A'B''C'$, Fig. 2*b*, the work being $\frac{1}{2}P(BB'')$. Now apply the H forces to bring the structure back to the condition shown in Fig. 2*a*; the work done by the H forces is $\frac{1}{2}H(AA' + CC')$, and that done on P is $P(B''B')$. The total work then is $\frac{1}{2}P(BB'') + \frac{1}{2}H(AA' + CC') - P(B''B')$. Since the total work must be the same in any case,

$$\tfrac{1}{2}P(BB') = \tfrac{1}{2}H(AA' + CC') + \tfrac{1}{2}P(BB'') - P(B''B')$$

$$\tfrac{1}{2}P[2B''B' - (BB'' - BB')] = \tfrac{1}{2}H\Delta l$$

Hence, $$\tfrac{1}{2}P(B''B') = \tfrac{1}{2}H\Delta l$$

or, $$\frac{H}{P} = \frac{B''B'}{\Delta l}$$

or the movement of the crown due to a unit change in span length is the same as the value of H due to a unit crown load.

Usual Formulas in Error—The crown of an arch exposed to temperature changes (Fig. 1) is, then, subject to a movement $CC' = h\Delta l/l$ due directly to the temperature change, and a movement $C'C'' = i_h\Delta l$ due to the fixity of the abutments, where i_h is the influence ordinate for crown thrust for a load at the crown, or $\Delta h = CC' + C'C'' = h\Delta l/l + i_h\Delta l = \Delta l(i_h + h/l)$. Textbooks give a formula similar to

$$\Delta h = ctl\,\frac{\int xy\frac{ds}{I} - \int x\frac{ds}{I}\int y\frac{ds}{I}}{\int y^2\frac{ds}{I} - \left[\int y\frac{ds}{I}\right]^2}$$

where c is the coefficient of expansion, t is the temperature change, l is the span, x is measured from the vertical center line, and y is measured from a horizontal through the crown. The integrations of the numerator are to be performed for half of the arch and those for the denominator for the whole arch ring. The term ctl is Δl, while the fractional term will be found to be the influence ordinate for crown thrust for a load at the crown. This formula, then, states that $\Delta h = i_h\Delta l$, and is erroneous in that in computing distortions due to temperature changes it entirely neglects the most obvious effect of temperature. These formulas, however, are correct if they are used to determine the rise of the crown with reference to tops of piers subject to similar expansion. They are not stated in such a way as to lead to such an interpretation, nor are they being so interpreted in connection with measurements of the rise and fall of the crowns of existing arches. The error is usually quite material, since for most arches i_h approximates $\frac{1}{4}l/h$ and approximately $\Delta h = \Delta l(\frac{1}{4}l/h + h/l = \frac{1}{4}\Delta l\ l/h(1 + 4h^2/l^2)$. In the case of a full-centered arch, neglect of the second term would then lead to an error of about 100 per cent. A brief search indicates that the error is not confined to American literature and that a similar error occurs in some discussions of steel arches, although Résal in Ponts Métalliques, 1885, p. 395, indicated the correct formula.

Other Disturbing Elements—It is, of course, evident that data secured from measurements made on arches with spandrel fill should not be used on arches with open spandrels nor the reverse. In the case of filled-spandrel arches there is grave question as to the proper treatment of temperature stresses; there is some reason to suspect that the rise and fall of the crown due to temperature results in a redistribution of the dead-load. Also, it would be interesting to determine whether the roadway above the crown follows exactly the movements of the crown itself. Another source of uncertainty is due to the temperature differential which may exist between the intrados, exposed to the air, and the extrados, exposed to the fill. While it is evident that, in the case of an arch of uniform section, this will produce no deflections, and that in general the deflections so produced will be small, the stresses due to such a temperature gradient may be considerable.

In arches with open spandrels, the effect of temperature gradient can scarcely be serious, even when the extrados is exposed to direct sunlight. Also the floor and spandrel posts cannot be expected to have any marked influence on the temperature deformations. In any case, since these elements are commonly neglected in design, their neglect in the study of temperature effects cannot be serious. The same may be said to a less degree of the uncertainties as to the action of temperature in arches having filled spandrels.

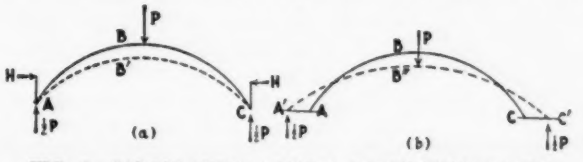


FIG. 2—CALCULATING CROWN DEFLECTION RATIO

Conclusions—From all these considerations we may conclude:

(a) That the movement of the crown of an arch gives an accurate measure of deformations due to temperature and similar causes in arches similarly exposed to the elements.

(b) These deformations may be computed by the formula

$$\Delta l' = \Delta l\,\frac{l'}{l} = \Delta h\left(i_h + \frac{h}{l}\right)\frac{l'}{l}$$

where Δl and $\Delta l'$ are the change in free span for the arch measured and for the arch to be designed respectively and correspondingly l and l' are the spans, and h is the rise and i_h the computed influence ordinate for crown thrust due to load at the crown in the arch measured.

(c) These relations are not materially affected by time yield of the concrete nor by variations of the value of E due to differences in the proportions of the concrete nor by rotation of the abutments.

(d) The measurements need not be made on the whole arch ring nor on fixed-end arches, but any convenient points may be taken or arches on elastic piers may be used, provided a correction is made for the change of span between the reference points.

(e) Precise measurements on the movements of an arch ring due to temperature furnish interesting material for study of the action of an arch ring, the elastic deflections being proportional to the influence ordinates for crown thrust.

Status of Death Registration Area

Only seven states were not within the death registration at the close of 1925. They were South Dakota, Nevada and Texas, which lack satisfactory registration laws, and Arizona, New Mexico, Oklahoma and Arkansas, in which laws are under trial. The Vital Statistics Division has set as its goal "every state in the registration area by 1930."

Road Progress in the South Atlantic and Gulf States

South Carolina	Louisiana
Georgia	Florida
Alabama	Mississippi

An Editorial Field Study of State Road Organization, Policies and Plans; the Trend of Highway Thinking; the Status of State Control; and the Progress in Engineering and Construction in Six Southern States

By John W. Shaver
Assistant Editor, *Engineering News-Record*

VI—Louisiana

THOUGH state supervision of road construction in Louisiana began in 1910 with the organization of the State Highway Department, the real work began in January, 1922, when the department was reorganized, the Louisiana Highway Commission formed, road expenditures put entirely under state control and considerable funds provided both for construction and maintenance uses. Therefore it is only during the last three and one-half years that Louisiana has done much state road construction, and considering what its difficulties have been, both in finances and construction, it has done remarkably well. During these years it has completed and put under maintenance most of the 3,850 of the 7,000 miles on its state system that had been put under maintenance. With few exceptions this completed mileage has been gravel surface. The state has felt the necessity for getting a large mileage in reasonable shape for fairly heavy traffic; paving with the hard-surface types being done on the heavily traveled routes as traffic conditions require and as the financial condition of the commission will permit. As an indication of the widespread and intensive activity in gravel construction which the state is following, from Oct. 1, 1924, to Oct. 1, 1925, 101 highways and 27 bridge projects were placed under construction, totaling 616 miles and costing $6,700,000; on Oct. 1 of 1925 bids had been advertised for the construction of 102 miles more to cost approximately $2,000,000; and on the same date projects had been completed and accepted totaling 601 miles and costing $6,200,000. In addition the engineers had surveyed and were busy upon plans for advertising for bids on 450 miles to cost $3,500,000. And during the past year or more at least 500 miles have been kept under construction at all times.

Early State and Parish Work—The first steps toward systematic road building in the state were taken in 1909. These first efforts toward state aid were made by agreement among the board of state engineers, the board of control of the state penitentiary, the United States Government and the police juries of the various parishes (counties) whereby state convicts were to be used for road improvement. As a result of this venture the 1910 state assembly passed an act which created the State Highway Department. That first act, together with a constitutional amendment passed in 1913, gave to the highway department authority to lend both supervisory and monetary aid to the parishes for road construction. The only money provided for such use, however, was an annual sum of about $140,000 derived from a state tax of one-eighth of a mill on every dollar of assessed valuation. This was the only money which the highway department actually had as its own highway fund until the passage of the 1921 law, which created the machinery for operation of the commission as it is now constituted. From 1911 to 1921 most of the money was supplied by the parishes in which the roads were to be constructed, though beginning with 1916 federal-aid was taken up.

Soon after the organization of the highway department, of which the state highway engineer was the head, it was realized that a definite system of market routes should be laid out upon which available state aid funds should be expended. Accordingly, a system comprising 7,000 miles was laid out that should interconnect all of the parish seats and principal trade centers of the state. Though this system was practically laid out before federal aid was available, the system was definitely numbered and the exact route designated by the law of 1921.

The Present Status—In 1921 the legislature passed three acts which created the State Highway Commission; defined a schedule of motor-vehicle fees and provided that the revenues, less the cost of collection, be turned over to the highway commission for construction uses; and placed a one-cent tax on gasoline, that fund also to go to the highway commission. Since that time, however, the gas tax has been raised by legislative act to two cents and the proceeds therefrom allocated exclusively to maintenance.

Under the provisions of those three acts the commission was organized. It is composed of three members, one a chairman, one a vice-chairman and the third a secretary. All of these are paid officers and spend their entire time in highway administrative duties. They are appointed by the governor for six years, though their terms overlap in two-year periods. The commission in turn appoints the highway engineer who selects his own technical staff subject to the approval of the commissioners. The civil service law does not operate in the case of engineers or clerks working in the highway department. The present state highway engineer is W. B. Robert, who has held the office for about one year.

The organization of the engineering forces of the commission presents a situation seldom found. The work is highly centralized. Practically all of the construction work is done out of the central office. It is under the general supervision of the construction engineer, but directly controlled by the three assistant engineers of construction, one of whom makes the home office at Baton Rouge his headquarters. All maintenance is controlled from the central office by the maintenance engineer. The state is divided into ten maintenance

districts each of which is in charge of a district maintenance superintendent, who in turn controls the operations of the patrols. Maintenance is wholly separate from construction. This is a practice which has been found to be effective in Louisiana because of the fact that immediately upon the acceptance of a road as constructed it is turned over to the maintenance department, and its maintenance begins at once. The rest of the engineering staff consists in a principal assistant engineer, whose duties are obvious, and the office engineer and two assistant engineers who make the plans and estimates for construction and carry on the other office detail. The bridge department, of course, has its separate engineer, and the testing laboratory, which by the way, is located in one of the new Louisiana State University buildings, is supervised by the testing engineer. Aside from field parties and inspectors this completes the engineering organization.

Construction and Maintenance Developed—The above engineering staff, which was practically the same at the organization of the commission in January, 1922, began the real work of state highway construction. The state was able to give adequate maintenance to the roads which had been built under its supervision but mostly with parish funds, and it had available a sum for construction far in excess of any it had had before. As an indication of this total money available, it is estimated that in 1926 $9,000,000 will be available for construction and about $3,000,000 for maintenance. The gasoline tax of 1925 will net about $2,500,000, as the one-cent tax netted $1,455,000 in 1924, the two-cent tax becoming operative in October, 1924. It is also estimated that the revenue from motor-vehicle licenses will give the commission close to $3,000,000 in 1926, the estimate for 1925 being $3,350,000 and the total for 1924 being $2,740,000. The highway commission also is given the funds collected from licensed chauffeurs, though this amounts to only about $60,000 annually. As the state now requires the parishes to pay half of the cost of all state-aid roads the construction funds from federal aid and the motor-vehicle tax are practically doubled, which gives the state highway commission its estimated $9,000,000 for 1926. It is interesting to note that though the state requires the parishes to furnish 50 per cent of the money for construction of roads within such parishes that are on the state system, the state highway commission has complete control over the administration of those funds—the same being turned over to the commission before construction begins—and the selection of type of paving, execution of contracts, etc. The parishes may offer some suggestions but they have no actual control over the expenditures. The state of course maintains all of the roads on the state system at its own expense.

In construction work Louisiana has followed to a large extent the progressive method which has its best example in the South in the state of North Carolina. The road to be reconstructed is first brought to standard width, grade, alignment and section, and the side drainage taken care of. Gravel is practically the only surface material used besides the accepted types of hard surface. Of that Louisiana so far has been able to do little, considering the better practice to be to get as large a mileage as possible in condition to carry moderately heavy traffic. The exception to the state's following the progressive system is found in the fact that it maintains only those roads which are constructed, making no attempt to touch the 40-odd per cent of its state-system highways until it is able to gravel surface them. As traffic becomes too great for the gravel, and as financial conditions permit, paving is put down. Bids are taken on alternate types, and the lowest bid, using any of these types, is generally accepted. These types are reinforced concrete, bitulithic, asphalt, topeka and brick.

Practice in gravel-road construction is well developed. During the past ten years there have sprung up all over the state commercial gravel plants, from which the state purchases all of its material. The standard gravel road is built of a loose thickness of 8 in. and a width of 18 ft. on a subgrade previously brought to proper alignment, grade and 24-ft. crown width. The subgrade is first thoroughly compacted and then the gravel spread. The gravel used is that which contains 60 per cent of pebbles retained on a ¼-in. screen. It must also pass strict hardness requirements. The gravel used is both washed and clay. The road is constructed with sufficient clay content to bind the surface. If washed gravel is purchased, because of the proximity of washed gravel plants to the job and therefore its better price, it usually contains about 85 per cent material retained on a ¼-in. screen. However the 60 per cent content is the standard and it is brought down to that with the use of roadside material. The price of gravel is an average of 60 cents a cu.yd. at the plant for 60 per cent ¼-in. pebbles and 70 cents for the 85 per cent, or washed gravel. Construction of gravel roads costs, including all items, about $12,000 per mile. That includes also the necessary small bridges that are to be found on the majority of state projects.

As previously stated all maintenance work is separated from construction, and it is handled through the ten districts by a maintenance engineer. Under each of the district maintenance superintendents are the foremen and laborers who make up the patrols. When a road is accepted as completed by the construction department it is turned over to the maintenance division and maintenance upon it begins immediately. The commission stresses this point. Maintenance does not wait for several weeks or months for signs of local breakups, but if a road is accepted Friday afternoon there is a patrol out over it on Saturday morning. The maintenance division has found that the greatest need for maintenance of a heavily traveled gravel road exists in the few months immediately after its construction. By careful patrol, therefore, the cost of maintenance has been kept to the minimum.

The mileage under each patrol foreman varies in accordance with the conditions of traffic and the character of the road. It ranges between 10 and 50 miles. Most of the maintenance equipment is motorized. Equipment is all repaired at the central shops of the commission but housed, except a certain reserve, at the smaller shops at the ten district maintenance offices. The average actual maintenance cost runs between $200 and $1,200 per mile per year. The average annual maintenance cost for all roads is about $500 per mile.

Contrary to a popular belief, especially one that exists in the northern states, all but about 20 per cent of the state is rolling country. One is apt to conceive of Louisiana as a state wherein constant drainage problems are cropping up in road building. There are certain sections of the state where drainage is a problem, but those are restricted principally to the far reaches of the Mis-

sissippi and Atchafalaya Rivers and the Gulf Coast section. Where swamp roads are to be built the usual practice is to use excavators to throw up a roadbed six to eight feet high, and allow that to settle and harden for about two years. A little traffic may go over it the second year, but usually it is left to consolidate as it will. It is then worked to a solid crust and the usual gravel surface put on. The trenches formed in throwing up the roadbed supply all the drainage needed.

There is a notable exception to this type of swamp road construction upon which bids are now being advertised. It is what is known as the Lake Shore section of the Hammond-New Orleans highway and when completed it will skirt the shore of Lake Pontchartrain on the south. The road is to be built by first running a deep ditch along the center line of the completed road and spoiling the excavation at either side forming berms. This will form a canal. Hydraulic dredges will then be put on the lake and material excavated from the lake bottom to fill the canal and the area between the berms to their full height. This will form a road, which is to be surfaced with shells, from 50 to 60 ft. wide. The completed project, about 15 miles long, will cost in the neighborhood of $1,500,000. It is the largest single road project that the state has yet attempted.

Foundation conditions do, however, make bridge construction in Louisiana a real problem, to which also the mileage of navigable streams and smaller waterways add their weight. There are approximately 4,800 miles of navigable streams in the state and it is estimated that to condition bridges now existing, or erect new ones, crossing these streams, will require the expenditure of $11,343,000. This figure does not include the innumerable smaller bridges which must be built to standard carrying capacity. There are about 75 major stream crossings on state highways. Half of these are either new bridges or reconstructed ones, the other half being old bridges and ferries. The foundation at many of these sites is almost bottomless and many projects will have to wait extraordinary appropriations, ferries serving the traveling public meanwhile.

Within the past three years the traffic on the main thoroughfares has so increased that the gravel roads are carrying more than double the number of vehicles that they could be expected to carry under the best construction and maintenance conditions. One highway, for example, is now carrying an average of 7,200 vehicles every 24 hours. And that is an average for a 7-day count. It is realized by the department that this road should be paved, for no gravel road can stand such treatment, but the money so far has not been forthcoming. That road will be one of the first that will be hard-surfaced when finances are available for paving. As a matter of fact studies made by Louisiana highway engineers show that Louisiana's gravel highways are getting a generally greater traffic than the roads of North Carolina. There are sixteen highways in Louisiana on which the average daily traffic exceeds 2,000 vehicles. It is estimated that on those roads there is being lost an inch in thickness of gravel each year. The cost of maintenance, also, is great. A few of these heavily-traveled roads are therefore costing, in loss of material and actual maintenance, between $1,500 and $2,000 yearly. Quite evidently higher types must replace the gravel and as soon as funds can be provided. Every year more miles of highways are being added to the list, and heavier traffic conditions are bound to ensue. As this is done and the maintenance cost mounts, the number of miles of new highways which can be built annually with a given revenue will necessarily become smaller. In order to save the present investment a large program for paving work must soon come. But let it be said in conclusion that so far Louisiana has done a remarkable job in reclaiming from the mud as great a mileage as it has in the short span of four years.

Dumping of Garbage at Sea Resumed by Oakland

Steamers, under Contract, Make Three Weekly Trips 30 Miles to Sea—Methods of Disposal in Other East Bay Cities

GARBAGE disposal by dumping at sea was resumed by the city of Oakland, Calif., in July, 1925. The former use of this method was stopped when the garbage steamer was wrecked in 1915 after some two or three years of use. The present contract is for a period of five years but the city authorities feel that there is every reason to expect sea dumping to continue indefinitely.

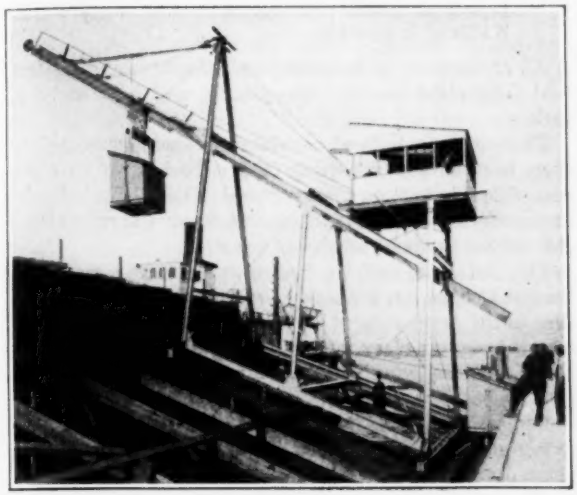
An attempt to dry and burn the garbage in concrete ovens was made some twenty-two years ago. This was discontinued as unsuccessful after it had been used for about a year. Then the tide lands were used as a dumping ground and this general method of disposal, except during the first period of sea dumping was used until last July. For a while material dredged from the bay was pumped over the dump. This covering was advantageous but part of the fill had to be kept dry so the wagons might haul over it and consequently this portion could not be covered with dredged material. The shore line on which Oakland borders is so located that prevailing winds carry any smoke, odor, flies, etc., that originate in the garbage dumps, directly toward business or residential districts and there have been many protests against disposal along the shore.

Under the new plan the garbage and trash, which amounts to about 250 tons per day and is collected by the city under allotment from the general fund, is hauled to the wharf and dumped into skips which are then lifted by a crane and dumped into compartments on one of two steamers operated by the Signal Steamship Co. with which the city has contracted for disposal. Schedules are arranged so that one steamer is always at the wharf. The contract price is 87c. per ton.

These steamers, fitted up to handle garbage, have a displacement of about 2,000 tons. The garbage is loaded in fourteen "side dump" compartments, well above water line. To keep the center of gravity low, 600 tons of ballast is carried in each boat. With this ballast the boats are said to handle very safely, even in rough weather, and in fact dumping is facilitated in rough weather by the wave motion which aids in emptying the compartments.

After each dumping, the compartments, which are equipped with steam and salt water pipe lines, are thoroughly cleaned before the steamer gets back into the bay. A city inspector accompanies the steamer on each trip to see that it goes to the prescribed point, some 30 miles through the Golden Gate, and that the cleaning is properly done before the boat returns. In addition to the garbage sent to sea a considerable amount

of refuse is burned on the tide flats near the garbage wharf. With this supplementary disposal taking care of combustible rubbish the garbage sent out in the steamers is of such character, that practically all of it sinks almost immediately after dumping, according to city officials. At the point prescribed for dumping, the tidal currents are reported to be such that anything that did demain afloat would not be carried back to the shore.



EQUIPMENT FOR LOADING GARBAGE AT OAKLAND WHARF

Trucks dump into large buckets standing at the edge of the wharf which are taken thence by the crane to the particular compartment being loaded.

Disposal at Alameda—Alameda dumps its garbage, tin cans, tree trimmings, etc., directly from the scavenger wagons into a fill 5 or 6 ft. deep on marsh lands at the west end of the city. Two or three times a week this dump is covered with 6 in. of earth which is hauled from excavations. The dumps are kept well sprayed with fly poison and an intensive rat trapping and poisoning campaign is conducted.

Although this fill is by far the cheapest method of refuse disposal, in the opinion of city officials, it is not altogether satisfactory from a sanitary standpoint and the removal of the refuse dumps to an isolated area on Bay Farm Island is contemplated. Refuse incineration, the city officials estimate, would require a $75,000 capital outlay and a monthly maintenance cost of $800 to $900. The maintenance of the sanitary fill has averaged $100 monthly.

Disposal at Berkeley—During the years prior to 1915 in which Oakland dumped its garbage at sea, Berkeley contracted for a share of the service and delivered garbage to the Oakland boat. Early in 1914, Berkeley erected an incinerator, partly because of a feeling that the ocean disposal was not wholly satisfactory and that refuse floated back to shore. (At that time the garbage steamer did not go far out to sea during bad weather.)

The incinerator is of the so-called English high-temperature type, housed in a substantial reinforced-concrete building. It comprises three furnaces, a combustion chamber to consume obnoxious gases, a 100-hp. boiler, forced-draft blowers and a stack 150 ft. high. When the incinerator is in use, garbage is delivered to a pit beside the plant where wood shavings are thrown over it as required. From here it is taken by a grab-bucket operated on a monorail crane and delivering to hoppers over the furnaces.

From the beginning the operation of this incinerator proved more costly than dumping at sea and after only a few weeks' use the city renewed the contract with Oakland for ocean disposal and shut down the incinerator, feeling confident, because of the possession of the incinerator, that a sudden cessation of the ocean disposal would not be embarrassing. Shortly after this, the garbage boat was wrecked and the incinerator was put in service again and was then operated continuously, except for brief shut-downs for repairs, until the spring of 1924. The city then began using the sanitary-fill method of disposal on marshy ground just beyond the incinerator on the bay side. This plan has been satisfactory and it is not expected that the incinerator will be again used as long as present conditions continue.

The average daily collection of household garbage in Berkeley is about 50 tons, to which is added about 27 tons daily of street sweepings. Collection is supervised by the bureau of garbage service which is under the city manager's office. The collection trucks have smooth iron bodies arranged so a plate placed at the front end can be used to pull out the entire load; with the gate removed, a cable is passed from this plate to a crawler tractor which provides the motive power for unloading.

Railway Work in Central Africa

ON THE recommendation of a special commission the British government has approved the guarantee of a series of loans, not exceeding $50,000,000, for the construction and equipment of about 1,000 miles of railway extensions in eastern Africa. One of these will be a northwestward extension of the Uasin-Gishu Ry., in Uganda, described in *Engineering News-Record*, Sept. 7, 1922, p. 400. Another development is the reported authorization of a bridge over the Zambesi River in Portuguese East Africa, connecting two north and south lines noted in the same paper. In Angola, the West African colony of Portugal, there are about 1,000 miles of railway.

Extensive relocations on the Trans-African Ry. have reduced the distance from the west-coast port of Loando to Malange to 250 instead of 315 miles. Two stretches of 60 and 32 miles were reduced to 37½ and 18 miles respectively. Material for an extension of this government line for 220 miles from Malange has been imported, but construction is being delayed. The Benguella Ry., further south, extending 387 miles eastward from Lobito, is being extended 62 miles. A further proposed extension of 312 miles across easy country will reach Moxico, in the Katanga copper-mining district. This line is expected to reach the eastern frontier by the end of 1927 and to connect with the railway system of the Belgian Congo by the end of 1928. These lines will eventually form part of a transcontinental line through central Africa. Another line in Angola is the Amboim Ry., 24-in. gage, of which 50 miles were opened early in 1925; a 30-mile extension is under construction to Huila, which will be the end of the line.

High Power Hydraulic Dredge for General Contracting

Speed-Up Gear Gives High Runner Velocity With Slow Speed Engine—A-Frame Barge Gives Mobile Discharge

By Jean M. Allen
Consulting Engineer, New Orleans, La.

A FEW years ago it was considered an axiom among hydraulic dredging contractors that a 20-in. dredge (i.e. one with a 20-in. discharge pipe) was the largest that it was economically feasible to operate. The principal arguments were that it was difficult to handle larger pipe on the fill, that there was a limit to the power possible to apply to the cutter, so that a 20-in. dredge could handle all the material that a cutter could loosen in any but the softest material, and that few jobs were offered contractors that justified the employment of a dredge of larger size. A 20-in. dredge can deliver from 200,000 to 400,000 cu.yd. per month, depending on class of material and length of pipe line, and up to a few years ago a 2,000,000-cu.yd. contract was considered a large one.

The Port of Portland, Oregon, having a large dredging program assuring continuous employment of its fleet, has built a number of 30-in. dredges but the United States government still standardizes in the 20-in. and 22-in. size, with a few exceptions.

In the last few years, some of the private dredging contractors have been increasing the size of their units The Reynolds Dredging Co., Inc., of New Orleans, La., has recently completed and put into operation a modern steam-driven 30-in. hydraulic dredge, which is one of the largest operated by a private dredging contractor in this country.

The dredge is now in operation on Section 5 of the Calcasieu Parish Navigation Channel. This channel extends from the Sabine River near Orange, Texas, to Lake Charles, Louisiana, and when completed will allow ships of deep draft to come from the Gulf of Mexico at Port Arthur, Texas, up the Sabine River to Lake Charles, making the latter a deep water port. The dimensions of the channel are 125 ft. wide at the bottom and 30 ft. in depth. The material excavated consists of some sand and loam but mostly of very hard compacted clay and marl.

The total yardage in the entire project is about 25,000,000 cu.yd., of which the Reynolds Dredging Co. has 3,672,000 cu.yd. in its contract on Section No. 5.

This dredge, the "Orleans," was designed in a general way along the conventional lines of steam-driven hydraulic dredges, although of exceptionally heavy and rugged construction, but has several unusual features, among them the method of driving the pump by a slow-speed engine through a speed-up gear, and the method of handling the shore discharge pipe.

The general design of the mechanical equipment was influenced by the fact that a great deal of surplus war marine equipment was utilized in its construction. This material was purchased at a surprisingly low price and enabled the builders to secure a very high-class piece of equipment at a comparatively moderate cost.

The hull was originally laid down for a 4,200-DW-ton collier of Isherwood construction, size 322 ft. x 44 ft. 9 in. x 22 ft. 4 in. Due to the slump in shipping, construction was stopped while the vessel was on the stocks, and the hull was purchased and cut down to the following dimensions:

	Ft.	In.
Length	169	10
Breadth	38	7
Depth	11	9
Length of ladder well	16	0
Width of ladder well	19	4

All of the plating is exceptionally heavy, ranging from ¾-in. keel plate to ⅜-in. side plating and ½-in. and ⅜-in. decks.

This made a hull of considerably heavier scantlings than are ordinarily used in a dredge hull of this size, and of double-bottom construction. These double-bottom tanks are utilized for fuel oil and fresh water, which is also rather unusual in dredge practice.

The A-frame, gallows frame and spud frame are of the usual type but of heavy construction. A novel feature is the arrangement of the gallows-frame back guys which are run clear aft to the spud frame above the house. These guys generally are brought down to the hull or hull truss and cut through the living quarters, causing considerable inconvenience. The deck house and living quarters are of wood, as this construction is considered cooler in a warm climate.

The main pumping engine is of the triple-expansion marine type with cylinders 19 in., 33 in. and 55 in. x 36-in. stroke, developing 1,500 hp. at 100 r.p.m. with steam at 210-lb. boiler pressure. This engine was built to propel a 4,200-ton composite ship, but was never installed and was about to be sold for scrap when purchased by the dredge builders.

The slow speed of the engine prohibited direct connection to the dredging pump and a Falk speed-up gear of a 2.4:1 ratio was installed between the pump and the engine.

This arrangement has many advantages. One of the greatest problems in steam dredges has been a matter of speed of engine and pump runner. Even with especially-designed short-stroke engines, the builders have not been able to produce a 1,200-hp. to 1,500 hp. engine having a much greater speed than 200 r.p.m. except at a very high cost. Even these engines are difficult to operate continuously at full power and speed, without heavy repair bills. As modern dredging conditions often involve pipe lines from 5,000 ft. to 7,000 ft. in length, this requires peripheral velocities of pump runners sometimes as high as 6,000 ft. per minute. A direct-connected pump, therefore, would require a pump runner nearly 10 ft. in diameter. A pump of these proportions has a very low efficiency, and the large size and weight render the first cost very high. The pump shell and runner are often worn out in a few months, and the cost of replacement is in proportion to the weight of the parts renewed.

The method of driving the pump through a speed-up gear has the following advantages: The driving engine can be of the slow-speed type as developed for marine propulsion which is of high economy, easy to maintain and capable of continuous operation without breakdowns. The pump can be of the high-speed type, light of weight, of high efficiency and economical in the cost of renewals. These advantages more than offset the cost of the gear, even if full price had to be paid for a new engine. The gear drive has proven very reliable in service. The builders claim an efficiency of 98 per cent.

The dredging pump now in service has 30-in. suction and discharge openings, and a 72-in. diameter runner. This particular runner was designed for a velocity of about 14 ft. per second in the pipe line against 90 in. total head—to suit the special conditions on this job. For higher heads a larger runner will be installed. The pump is of cast-steel construction with solid shell and lined front and back heads.

Steam is furnished by four Shipping Board type water-tube boilers with a total heating surface of 10,000 sq.ft. The steam pressure is 210 lb. Oil fuel is used and is fired by means of a Todd high pressure mechanical fuel oil system with three burners to each boiler.

The digging ladder is of plate-girder construction 65 ft. long. A six-blade open type cutter 103 in. in diameter with renewable manganese steel blades is driven by a 500-hp. double engine having cylinders 14½x15 in. taking steam at 175-lb. pressure. The engine and gearing are mounted directly on the ladder. The ladder complete with engine shafting, cutter, and suction pipe weighs 116 tons. The dredge can dig to a depth of 45 ft.

A five-drum Bucyrus hoist provides power for raising the ladder and spuds and swinging the dredge. It is driven by a 10x12-in. double-cylinder engine, and all frictions are operated by steam rams. The digging swinging drum has a rope pull of 50,000 lb., all other drums 38,000 lb.

The spuds are of unusually heavy construction. They are of steel riveted construction 39 in. in diameter of 1¼ in. thick steel and are 79 ft. long, over the cast-steel point, and weigh 40 tons each. The spuds are attached to the stern of the dredge by a very heavy structural steel framework and travel in cast steel guides, provided with swinging gates which enable the spuds to be removed without lifting them out of the guides.

The usual equipment of auxiliaries, such as condensers, pumps, evaporators, distillers, light and refrigerating machinery is installed, all of the latest marine type. Much of this equipment is salvaged ship equipment from the scrapped wooden fleet.

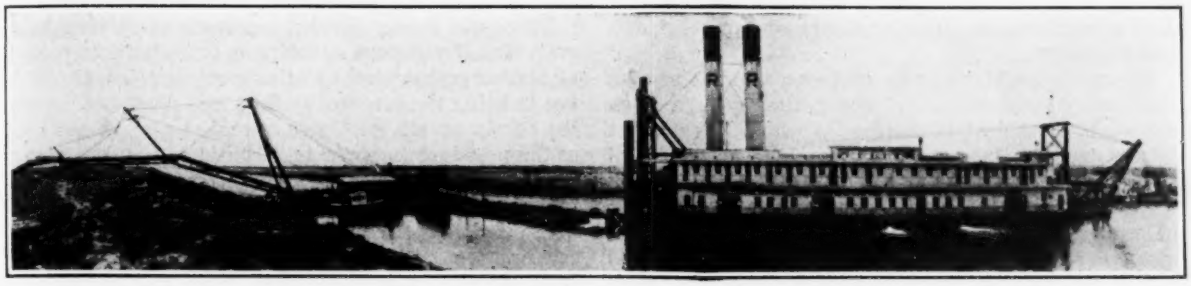
The repair shop has a very complete equipment consisting of blacksmith shop, two lathes, two drill presses, shaper, power hack saw, emery grinder, air compressor and arc welding equipment.

Living quarters for 80 men are provided on the upper deck and are complete with all modern conveniences.

The work on which the dredge is engaged consists of widening and deepening an existing canal. Spoil banks along the side of the old canal provide a means of using a rather unusual method of disposing of the excavated material, by suspending the discharge pipe in an overhanging position from a floating barge in such a manner that the excavated material is discharged over the levees. Sliding valves are provided in the bottom of the pipe so that the heavy clay and sand can be bled from the pipe to build up the levees, in case they are not high enough to prevent the spoil from running back into the canal.

This barge, which carries the discharge, is 111x35x7½ ft. in size. The 30-in. discharge pipe overhangs the end of the barge a distance of 120 ft. and is supported by a steel frame and guys, as shown in the accompanying illustration.

The pipe on the barge is connected to the dredge by a floating pontoon line of fixed length. The shore discharge barge advances as the dredge moves ahead, and it is never necessary to stop to put in pontoons nor lay shore pipe, so that the operating of the dredge is practically continuous, as far as discharge is concerned. This method of operating has resulted in a very considerable saving of time and labor. The crew usually employed to handle the shore pipe consisting of about fifteen men is dispensed with and from two to three hours per day running time of the dredge is saved by not having to stop to put in pontoons and add shore pipe.



PANORAMA VIEW OF DREDGE, PIPE LINE AND DISCHARGE BARGE ON CALCASIEU CANAL, LOUISIANA

The dredge and discharge scow arrangement were designed by Jean M. Allen & Co., consulting engineers, of Chicago and New Orleans, and were built in New Orleans, by the forces of the Reynolds Dredging Co.

New Plan of Road Location in Sand Dunes

Road construction and maintenance methods across the drifting sands of southeastern California have been revised in the light of experience there with state highways. Commenting on this situation in a recent paper before the San Francisco section, American Society of Civil Engineers, R. M. Morton, chief engineer of the California State Highway Commission, said, "In maintaining roads in the drifting sands we have learned several ways to protect the highway. We have found that cuts made parallel to the direction of the prevailing wind through a sand dune will sometimes result in its disappearance in a single wind storm, whereas, without the channel the dune will move and cover the highway. We find that excavations made at the base on the lee side of an approaching dune will cause air currents which will arrest the forward movement of the dune. As the result of two years' study the grade line on the highway now being advertised for contract across the notorious 7 miles of sand hills in Imperial County is established within a few feet of the top of the dunes and by protecting and oiling the slopes of the embankments we expect that the sand will blow across the highway rather than lodge upon it in any great quantity."

General Contractors Make Progress Toward Ideals

Most Critical Year of Association's History Ahead—Day Labor, Government in Business, Bonding Situation and Legislation Discussed at Portland

"A LONG STRIDE" toward objectives that the Associated General Contractors are striving for was announced at the opening session of the seventh annual convention in Portland, Ore., Jan. 19, in the adoption by the United States Chamber of Commerce of a report favoring contracts instead of day-labor construction. This encouragement to the meeting was the signal for greater effort on other problems and much work that is yet to be accomplished was discussed constructively and laid out for officers, committees and members for the coming year. As announced in the news section of *Engineering News-Record* last week, the convention was well attended and had so much business before it that no time whatever was left for sightseeing or other outdoor diversions.

The major problems to be confronted in the coming year were clearly outlined at the opening session in an address by President Walbridge, in which he said that the construction industry now faces the most critical period in its history. He called upon the industry to rally to Association work, urging that all members undertake their share of the work to be done. He placed day-labor work and government in business as first on the list of problems demanding attention; next to these is the surety bond situation, a menace so serious that it even threatens destruction of the construction industry. He stated that lien laws do not now protect the public and must be revised; that the growing tendency of architect and engineer to deal with sub-contractors direct threatens the existence of the general contractor; that a department on legislation is imperative to cope with proposed destructive laws of which more than 400 were introduced in the last legislatures, and, finally, that greater co-ordination of collective effort in the common interests of the industry is imperative.

Committee Reports—The report of the finance committee showed the association to have "gone through the year without borrowing or begging." In commenting on this showing and the need for the work now only begun, R. C. Marshall, Jr., pointed out that general contractors have neglected the fundamentals of their industry while others have laid such restrictions upon it as to tend to make of contracting a gambling business. Increased expenses were approved to the extent that a 1926 budget of $120,000 was authorized.

The committee working on a day-labor bill for presentation to congress has completed a measure that limits to 10 per cent the amount of public work that can be done by day labor and that differentiates between construction and maintenance.

The subject of quantity survey bureaus was discussed from numerous angles; six chapters now operate such bureaus and believe the method saves time and money. For the most part contractors prefer to check the bureau's figures, using it as an aid and a guide rather than an estimating department. An association committee to work on the standardization of plans for the operation of survey bureaus was urged.

Surety Bonding—The surety bond situation brought out a general discussion in which intense interest was shown. Views contrary to the committee's report were presented, their purport being that it was not the surety company itself but rather the agents who were at fault and that another effort should be made to get the surety companies to improve conditions. In support of this view the Surety Association's recent book was said to contain no criticism of general contractors and on the other hand made the constructive suggestion that where surety companies were repeatedly bonding irresponsible contractors, the industry as a whole could effect a remedy by placing their surety business accordingly.

There was a very decided consensus of opinion, however, that the present situation is too critical to permit of further postponement while surety practices are tending to bring the contract method into disrepute. Since the surety agents, getting a commission of 35 per cent of the premium (a percentage considered far too high), are constantly under the temptation to connive with irresponsible contractors in getting bonds, it was believed that it is the duty of the surety companies themselves to remedy the situation. Insurance in other fields is on a much more substantial basis and in the construction field the influence of concerted national action was felt to be essential in securing the changes that must come. After long discussion in two sessions, the surety committee report was unanimously adopted.

Building and Safety Code—Discussion of the building and safety code report brought out differences of opinion as to the need for laws covering this phase of construction which is also being covered in great detail by the Engineering Standards Committee, but the meeting was strongly in favor of the Association's committee report consisting chiefly of a set of rules of standard practice. These rules, comprising 64 provisions, had been drawn up by the committee in an endeavor to secure a comprehensive statement of the principles of safe building construction rather than detailed specifications of sizes, types and materials to be used in safety work. Because accident prevention cannot be accomplished by laws and must of necessity be chiefly a campaign of education, no safety code could be all-comprehensive. Furthermore, where safety laws are passed if they attempt to include too much detail they fail in their objective and are more dangerous than useful. Accident rates have increased of late, it was stated, in the eight states that now have and enforce stringent accident prevention laws. Widespread adoption of the rules of standard practice rather than to propose any legislation would be helpful, it was believed, in warding off drastic, undesirable laws and without imposing undue restrictions where no legislation is now contemplated. The A. G. C. recognizes the obligation resting upon it to assume leadership in accident prevention on construction work.

The Day Labor Report—The United States Chamber of Commerce report on day labor as compared with contract work in public construction was easily the outstanding feature of the first day's session. In presenting

this report, Arthur S. Bent, Los Angeles, explained that it was the result of some two years' work and that the subject had been most exhaustively studied by the committee before the report was drafted, revised and finally adopted. Essential features of the report follow:

Of the $6,000,000,000 spent annually in the construction industry in this country about $2,000,000,000 is for public construction, of which about one-fourth is now being spent for work done by day labor. A comparison of the merits of contract and day labor methods leads the committee to conclude that in general the construction was done better, at lower cost and in less time by the contract method. Better because workmanship and quality of materials and methods are subject to the rigid inspection of the owner; in less time because the contract fixes time limits and provides penalties for delay; at less cost because the work is awarded to specialists under competition and done under a guarantee of completion within the amount bid, and finally, the work cannot be undertaken without careful study and complete preparation of plans made in advance. Taxpayers, it was held, are entitled to the security of completion on time and within the amount bid which can be obtained only by the contract method.

Under the day labor method, on the other hand, public officials, not chosen for office because of training and success as construction managers, it was pointed out, assume charge of great projects without guarantees as to cost, quality or time of completion of the work and there is no disinterested check on changes in plans, methods or materials. Payrolls are likely to be excessive, no surety company guarantees the work, and no one assumes any financial responsibility; when the money is gone Congress or the people are asked for more. Coupled with these facts is the well-known inefficiency of labor in government employ as compared to the same labor employed by private enterprise. The most common argument for day labor, namely saving the contractor's profit, is a fallacy: the skill, experience and trained organization of the contractor enable him to earn a profit in competition with day labor. To sum up, the day labor method on public construction tends toward waste and inferior workmanship, cripples individualism and personal initiative, stifles industry, demoralizes labor and builds political machines. For these reasons the committee recommends that:

(1) Complete plans and specifications for public work should be prepared in advance.

(2) Based on these plans a cost estimate should be prepared and made public.

(3) Competitive bids should be invited and should become a public record.

(4) Whenever work is done by day labor a modern accounting system should be established to show accurate and complete costs.

(5) When public work is completed sworn itemized statements of cost should be made public so comparison of original and final costs may be made.

In commenting on the report Mr. Bent said, "This is a long stride toward curing the serious evil of constructing public works by day labor and it only needs adequate publicity to make it effective." This report, it was stated, will be circulated by the Chamber among 800,000 business men throughout the United States.

Relations with the Engineer—A sharp distinction between the functions of engineer and contractor was drawn at the meeting of the public works, highway and railway division. The engineer's function, it was held, is to seek the lowest construction cost for his principal. He can ascertain costs of materials and labor but actual responsibility in construction such as only a contractor will have is essential in estimating overhead, plant, obsolescence, seasonal idleness, upkeep of equipment, etc. Estimates of engineers are of little use to contractors unless the latter are thoroughly familiar with the personal equation of the estimating engineer and his manner and method of estimating.

Public and private owners would be better served, it was agreed, if engineers were to plan and design projects in all their details, make accurate quantity estimates, ascertaining kinds and characters of physical materials and conditions encountered and present this full information to the bidding contractors who would analyze each job thoroughly and apply the practical unit or lump costs in reaching their final cost estimate. In other words, the advance financial estimates which the owners may require of the engineer should not be known to the bidding contractors.

The sense of the meeting was that the under-payment of engineers by owners and the public is most deplorable because it tends to put in the hands of young and inexperienced engineers the planning and supervision of great projects on whose construction the contractors' superintendents have greater responsibility and receive much larger salaries than do the engineers in charge.

Supplementary courses in engineering schools that will give the student training in administrative and executive work were suggested in the report of the committee on co-operation with highway officials. But few engineering graduates, the report stated, find work that is 100 per cent technical and because their training was exclusively in technical lines they are not equipped as they should be for important management work in the construction fields.

Railroad Construction—Speaking on "The Future of Railway Construction," W. H. Kirkbride, engineer maintenance-of-way and structures, Southern Pacific Co., reviewed the development of railways in this country through the period when they were subsidized and encouraged in every way down to the present time with a total trackage of about 250,000 miles. Railways are so intimately associated with the social and economic features of American life, he said, that progress of all kinds depends on the successful operation of the railroads and that means the railroads must continuously grow and expand.

The federal government has changed its attitude toward the railroads since a 32-month period of federal operation and guarantee during the war resulted in a deficit of $1,900,000,000. Under the present laws the railroads are recognized as a vital necessity to the life and well-being of the country. However, earnings are limited to 5½ per cent on the capital invested with no opportunity to accumulate a surplus in good years to tide over the lean years. This limitation tends to deter new capital from entering the railroad field. Competition from water-borne freight through the Panama Canal, from airplane mail carriers and from motor traffic, together with demands for better service, new equipment and new terminals, has confronted the railroads with many problems.

On the other hand, the low population density of the entire western United States and the natural resources of the country assure great future development and attendant transportation business. Looking forward

to this development to come, extensive improvement of transportation facilities will be made, first in the form of betterments on existing systems such as the replacement of timber structures with steel and concrete, line and grade changes, long tunnels through mountain ranges, better siding and terminal facilities and finally second and multiple tracks on main lines. Grade separation will be an item of increasing importance in this development of the railroads.

Notable advances in locomotive design have postponed the day of electrification, Mr. Kirkbride believes, except in city terminals and in long tunnels. Consolidation of systems does not usually include the elimination of mileage popularly supposed to be eliminated, but rather additional construction may be expected for inter-connections and larger terminals. Witness the recent consolidations in Arizona, New Mexico and Texas which involved, in addition to other work, the construction of 170 miles of new track before the desired economical unification was secured.

Resolutions—Resolutions were voted condemning bonding practices, urging modification of lien laws, supporting arbitration urging higher pay for engineers and calling for strict accounting in day-labor construction. The resolution relative to day-labor construction of public works was as follows:

BE IT RESOLVED by the Associated General Contractors of America in convention assembled that full information as to the cost and wastefulness of projects built by public forces be given to the public wherever possible; that this association co-operate with other industries in revealing the purposes and results of these public business ventures and that the enactment of laws requiring operations conducted by public forces to be fully accounted be undertaken in the various states.

The Board of Direction also passed a strong resolution against any raises in price of materials or labor at the present time. It believed that construction is very near if not already at its peak and a slump menaces. Large and increasing areas in most cities are vacant. Rents are down. There are many signs that we are built up. Action included telegrams to Secretary Hoover and to the two New York financiers who recently sounded the same warning approving their attitude, and also instructions to the membership of the association to preach the gospel of stabilization to the chambers of commerce and luncheon clubs over the country. The Board feels that it is a time to increase production and keep prices down and use all means to prevent a sudden reaction.

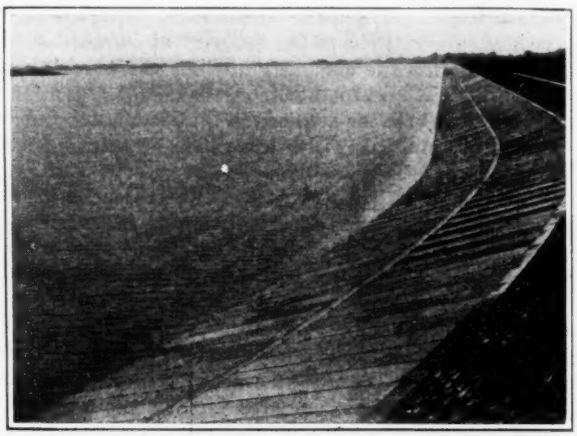
Teredos Destroy Timber Structure Rapidly

In the construction of the flexible pipe line across the upper end of San Francisco Bay a structural-steel cradle with untreated timber framing, pipe guides, etc., was used which was submerged in the Bay waters for a period of about three months. When the work was completed and the cradle was lifted from the water the timber portions were found to be so riddled by the boring of teredos that they fell apart under their own weight. The Hetch Hetchy line crosses the Bay at a distance of about 30 miles from the Golden Gate; there are no streams of any considerable size running into this end of the Bay.

Huge Reservoir and Pumping Plant for London Water Supply

Four 103-M.G.D. Centrifugal Pumps Driven by Uniflow Engines Lift Water Into 7.9 Billion-Gallon Storage Reservoir

A RESERVOIR to store nearly eight billion (U. S.) gallons of Thames River water for London and vicinity was dedicated by the King of England on June 13, 1925. It will be filled by a 300- to 412-U. S. m.g.d. pumping plant consisting of centrifugal pumps and uniflow steam engines located at the reservoir. Besides the reservoir and pumping station, new construction includes a river intake at which there are bar screens and three large Venturi meters; an open channel about three-fourth miles long ending in a suction pool; short pump-delivery pipes of steel discharging over the reservoir embankment; and, at the other end of the

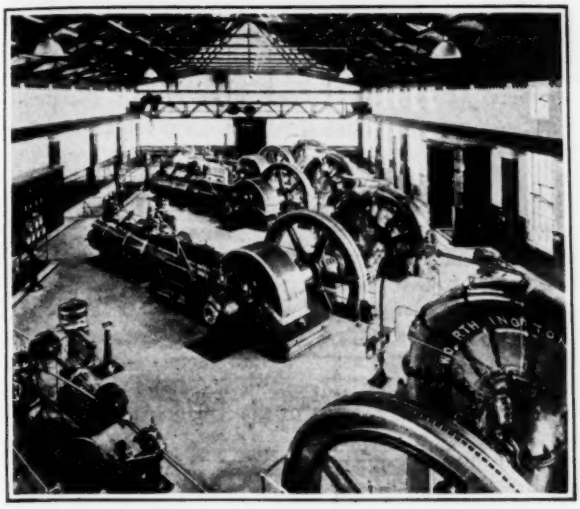


QUEEN MARY RESERVOIR, LONDON WATER DISTRICT

reservoir, outlet works and connections with existing conduits to existing pumping stations and filters.

Fourteen years have passed since the bill authorizing these works was introduced in Parliament. Construction was begun in 1914. Due to the War, work went on spasmodically for 18 months, then was suspended in February, 1916. In 1919, a new contract for the reservoir was let to S. Pearson & Son, Ltd. Up to the time of the dedication the project was known as the Littleton reservoir, but it has since been named after Queen Mary. The project has been carried out by the Metropolitan Water Board, after original designs by the late W. B. Bryan, the first chief engineer of that body. After Mr. Bryan's death the plans were altered by his successor, the late James Restler, who was deputy chief engineer under Mr. Bryan. Mr. Restler was succeeded by Henry E. Stilgoe, the present chief engineer, who has carried the project to its nearly completed state, with T. C. Deverell as resident engineer. The text for this article, except the credits to engineers other than Mr. Stilgoe, is based on detailed descriptions of the project published in London *Engineering* for May 15 and 22 and June 5.

Intake, Venturi Meters and Open Channel—At the river intake the water passes through bar screens spaced 2 in. apart in the clear; then through three sluice-gate channels to and through three concrete Venturi meters, each designed to register flows of from 12 to 120 U. S.



NEW PUMPING PLANT, LONDON WATER SUPPLY

m.g.d., and each 4 ft. 10 in. in diameter at the throat, lined with gun metal at the mouth and throat; and then through three sluice-gate channels to and through an open trapezoidal channel, with concrete-block paving on the wetted part of the side slopes. At the pumping station this channel discharges through bar screens into a covered suction-pool at the outer foot of the reservoir embankment. The pool is 20x94 ft.x16½ ft. high, internally, with concrete walls and a reinforced-concrete beam-and-slab roof. From the pool four concrete tunnels lead to the pump suctions. Each tunnel starts with a diameter of 7 ft., then tapers successively to 6, 5 and 4½ ft., the last taper being in bends lined with riveted steel.

Pumps and Boilers—The pumping plant has a total capacity of from 300 to 412 U. S. m.g.d., with heads of 46 to 30 ft. It is in four units, each consisting of a 48-in. centrifugal pump driven by a single-cylinder horizontal Worthington-Simpson uniflow steam engine. The pump horsepower of each unit is about 600. The steam pressure is 200 lb. per sq.in. and the superheat 200 deg. F. Each engine develops 770 brake horsepower when running 140 r.p.m. and delivering 75 U. S. m.g.d., against 46 ft. head, the overall efficiency being 79 per cent. The maximum efficiency (81 per cent) is got at 130 r.p.m., against a 37-ft. head, with brake horsepower of 720 and a delivery of 90 U. S. m.g.d. At a 30-ft. head, 125 r.p.m., and a delivery of 103 U. S. m.g.d., the efficiency is 77 per cent and the brake horsepower is 704. These efficiencies are based on a guaranteed overall coal consumption of 1.85 lb. of bituminous nut coal with a value of 11,000 b.t.u. per lb. per hp.hr. on a 24-hr. test.

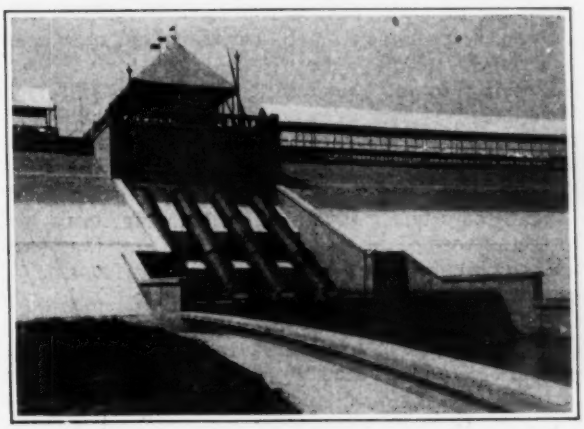
Bids for the pumping plant were invited on general specifications, the award to be based on the lowest annual total charges, as calculated from the contractor's bid and data given in the specifications. These data included probable average continuous horsepower; estimated cost of bituminous coal, anthracite "beans," and fuel oil with respective values of 11,000, 13,500 and 19,000 b.t.u. per lb.; cost of buildings per cubic foot, wage rates, capital charges, including depreciation on expected life of various classes of machinery.

There are four chain-grate, stoker-fed Stirling boilers, with room for a fifth, each with an evaporative capacity of 8,300 lb. per hr. Coal is delivered to the station by "lorries," dumped into a hopper, again dumped into chain-belt conveyors and dropped as desired into the bunkers that feed the stokers.

Reservoir—The reservoir is an irregular seven-sided polygon with rounded corners, with an area of 723 acres and a water depth of 38 ft. when full. It is chiefly in earth embankment, averaging 38 ft. in height above the average ground level and extending 6 ft. above the maximum water level. A clay puddle heart-wall is carried down into the London clay. The inner slopes are 3 to 1 and the outer 2½ to 1. The outer slopes are covered with 3 ft. of soil in which shrubs are to be planted. The water slope is paved with 6-in. concrete slabs below and concrete blocks above, with a coping of concrete having a concave face to throw back the waves.

To promote circulation of the water and reduce wave heights a baffle embankment 4,000 ft. long has been built across nearly the width of the reservoir between the inlet and outlet, which are on opposite sides. The bank is of earth, without heart-wall, with concrete-paved slopes of 4 to 1 for the lower and 3 to 1 for the upper portion.

Reservoir Outlets—The outlet from the reservoir to the conduits which lead to the various existing pumping stations and filter plants is an octagonal concrete downtake shaft, 136½ ft. from the center line of the embankment, supplying a tunnel lined with cast-iron segments, brick and concrete, which extends beneath the embankment to an uptake shaft which feeds two 8-ft. reinforced-concrete conduits, each controlled by a sluice gate. The downtake shaft has six inlets at different levels. Each of the two conduits supplies water through a 4-ft. connection and a gaging tank and submerged weir to a previously existing aqueduct, after which the 8-ft. conduits are reduced to 6 ft. and one is capped, the second connecting with other existing aqueducts.



PUMP DISCHARGE PIPES, QUEEN MARY RESERVOIR
Central canopy to shelter King George during dedicatory speech.

The gaging tank is of concrete, 22 ft. wide. Water is admitted to it through side openings in rectangular vertical shafts, flows over and under four concrete baffles, and passes out through a submerged weir 13 ft. wide and 2 ft. high, the orifice proper being a sharp-edged gun-metal plate fastened by countersunk gun-metal screws to a cast-iron plate bolted to the concrete wall. Connections from each side of the orifice to the gage house are made by means of 4-in. cast-iron pipe with hub-and-socket joints. The weir delivers to a short rectangular channel leading to one of the aqueducts.

210-Ft. Airship Mooring Tower at Detroit Airport

With New System, a Dirigible Lands Passengers and Freight at Ground Instead of at Top of Tower — Bow Held in Sliding Guide as Ship is Hauled Down—Anchor Trucks Restrain Ship's Hull

By Herbert V. Thaden
Chief Designer, Aircraft Development Corporation, Detroit, Mich.

COMMERCIAL requirements of an airship port were the controlling factors in the design of the first privately-owned mooring tower in the world, which is the tower designed and built for Henry Ford by the Aircraft Development Corporation and erected on the new airport at Dearborn, Mich., about a half-hour's ride from Detroit. Studies of existing methods of mooring, and of conditions which might exist at an airport like Detroit, were made before starting the design. A view of the tower is given in Fig. 1.

Large commercial dirigibles will be required to dock and discharge their cargoes of mail, passengers and express quickly and safely, not only on fine days, but also in heavy rains and winter storms with ice and snow troubles. Fortunately, the latter troubles become serious only while the ship is being docked, or is riding at the tower. When the ship is under way, it can avoid the sleet by rising into drier atmosphere, while its velocity in flight tends to keep sleet and snow from adhering.

Mooring towers, originated by the British, have altered the status of airships and have contributed more than any single factor in recent years to make a safe and reliable airship service possible. Formerly these "fair weather ships" could be taken in or out of their hangars only under favorable weather conditions and in the absence of cross-hangar winds. Now they have become year-round commercial transports capable of leaving their docks (towers) at any time. Primarily the mooring tower has been a success because it enables the airship to make a coupling with a fixed ground object while the ship is still many hundred feet in the air. Docking a ship in this way requires only ten or fifteen men, whereas the older systems required several hundred men to catch and hold the ship, as soon as it came near the ground, in order to prevent it from injuring itself by sudden impact with the earth.

Ordinary Mooring System—The British method of mooring, developed by Major G. Herbert Scott, of the British army, utilizes in succession the single, the three-wire and the fixed-bow type of mooring. By this method, a single cable is dropped from the ship's bow to the ground, where it is coupled to a station cable which has been led from a winch at the base through the top of the tower and out on the field. Then this latter cable is reeled in through the top of the tower until two shorter yaw-line cables, about 450 ft. long, also from the ship's bow, are coupled with similar station cables leading on either side of the down-wind position to yaw-block anchors on the ground. There are twenty-four of these blocks at the Ford tower, equally spaced on a circle of 625-ft. radius. From these blocks the cables are led to yaw winches at the base of the tower. The main cable and two yaw-line cables are reeled in until a male cone on the ship couples and latches into a female cone on the top of the tower. The ship then rides to the top of the tower, turning as the wind shifts, the bow always headed to the wind.

With the ship only approximately in equilibrium, supported at one point at the extreme bow, great care is required to maintain a level position and to distribute the weights along the keel, so that their moment about the bow is always equal to the moment of the lift of the buoyant gas. The movement of a man from bow to stern of the "Shenandoah" (600 ft.), while in still air, caused a change of several degrees from the horizontal trim. Skillful control was required, therefore, for the transfer of passengers and cargo along the keel. The process was necessarily slow. Furthermore, cargo and passengers in the present method of mooring must be transferred from the center of the ship about 300 ft. horizontally and 40 ft. vertically to the small gangplank at the bow of the ship. They are then lowered down a small elevator about 200 ft. to the ground. This is analogous to the transfer of a ship's cargo by small lighters to an inaccessible shore because of the absence of proper docks.

FIG. 1—AIRSHIP MOORING TOWER AT DETROIT
At left of tower is the revolving guide for the ship's bow as the airship is hauled down for landing.

New Mooring System—The system at the Ford tower obviates the tedious transfer of cargo and passengers, noted above, and it also provides a safe mooring in the event of sleet and snow storms. In addition, it provides ready means of changing an engine unit, repairing a gas cell or making other minor repairs with safety and dispatch. This facility is specially important in the absence of a hangar. The general arrangement for mooring and control is shown by Fig. 2.

Bow mooring at the top of the tower permits the ship to assume vertical angles of pitch as well as to yaw or swing horizontally around the tower. The latter is essential to the safety of the ship, but the former is undesirable. This pitching motion will be controlled by restraining the stern, hauling the ship down to the ground and coupling its control car and one of the rear power cars to small trucks on the ground. The weight of these trucks will be sufficient to keep the ship from rising and all down loads will be taken directly through them to the ground. The vertical guide, down which the bow rides as the ship is lowered, is rotatable around the outside of the tower, thus allowing the ship to swing horizontally. This guide is motor-driven and

is automatically controlled by the ship's position and angle of yaw, so that it is always on the down-wind side of the tower.

Passengers may step down a gangway from the passenger cabin to the ground and the cargo can be placed on delivery trucks driven directly under the ship's hatches. All of this can be done without special reference to the trim of the ship, because the restraint of the ground trucks eliminates vertical motion and removes the largest stress factor on the ship, that due to shock load. In the event of an overload due to ice or snow, too rapid discharge of passengers or cargo, or the accidental deflation of a gas cell, the excess loads are safely taken through the ground trucks, which will be provided with motive power by which they can be kept automatically centered under the ship. As soon as the ship swings a small distance, an electrical contact

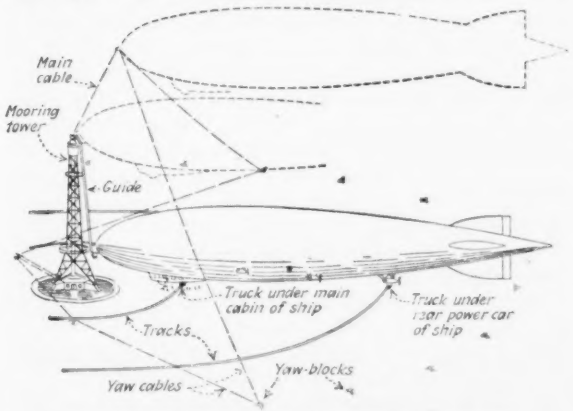


FIG. 2—MOORING AND ANCHORING SYSTEM

will actuate the truck motors and bring the truck under the ship. The ship is therefore not subject to more than approximately a hundred pounds of lateral force.

Control of the position and trim of the ship during the haul-down is obtained by dropping cables from the control car and the rear power cars to the ground trucks. Ballast is then discharged until each cable has several thousand pounds tension. Then the ship is hauled down. Aerodynamic down-loads in excess of the cable tension are required before the ship can be forced down by the wind, and the buoyancy must exceed the weight of the ground trucks before the ship can rise.

Although the normal docking is in the ground position, the top mechanism was so designed that the ship can remain riding at the top if desired, as in case of a short temporary stop, or when an emergency getaway is contemplated in bad weather. The servicing facilities include buoyant gas, gasoline, water, telephone and electric light, as on the masts of the U. S. Navy.

Tower and Guides—The tower is a three-legged steel structure, 210 ft. high, composed of a portal 51 ft. high, 72 ft. wide at the base and 30 ft. at the top. Above this the tower tapers, in 116 ft., to a 16-ft. cylinder which serves as a shelter and as the top landing stage for the elevator. Above the cylinder is the mooring mechanism, composed of a rotatable deck running on circular rails mounted on top of the cylinder, a horn-shaped guide supported by an A-frame, and a shock absorber. The height of this mechanism, shown in Fig. 3, is about 17 ft. Below the curved horn is a straight guide which extends down to about 6 ft. below the top of the portal and is rotatable, as already noted. It is supported by several horizontal circular tracks around the tower. This guide is a U-shaped girder having on each leg a T-section guide on which slides the mooring cone carriage. As the carriage in sliding from its top position down the side alters its axis from the vertical to a horizontal position, it is made of two cones, the inner one having an inside bore machined to receive the standard male cone of the airship coupling. It rotates on ball and roller bearings inside of the outer cone. The latter is pinned between two cross arms, which enable the cones to rotate on a vertical axis when the carriage is down the side of the tower. A total yaw of the ship of 60 deg., or 30 deg. either way, is obtained before the rotation of the carriage and guide is necessary.

The rotation of the inner cone enables this cone and the ship, when the carriage is at the top of the tower, to rotate about the center-line of the tower. To facilitate pulling the carriage around the curved horn, the cross-arm supports, bearing the cones, have small rotatable and slotted bronze shoes which slide on the T-guides. A manually operated pin enables the two cones to be locked when relative rotation is undesired, as when the carriage is down the side and the yawing motion on the two vertical pins only is required.

There are three positions of the carriage on the vertical guide: (1) the extreme top position, where the center-line axis of the carriage cone coincides with the center-line of the tower; (2) the landing position, where the carriage is moved down the curved part of the horn some 4 ft. and the center-line of the cone is inclined 35 deg. from the vertical axis; and (3) the side position, where the carriage is at any position along the vertical guide and where the center-line of the cone is horizontal.

Hauling and Guide Mechanism—Stop and safety latches are provided at the extreme top and down on the side of the horn at the landing position. A hand-operated winch at the upper end of the horn, with a short length of cable, controls the carriage from the landing position to the top position. Hauling-down is done by a small cable running from the carriage to a drum at the bottom of the vertical guide. To lower the carriage on the vertical guide, the main haul-in cable is brought into use to suspend the weight of the carriage and control its speed. At such time this cable will have no other use, as its chief function of hauling-in the ship will have been completed.

The entire top mechanism is mounted on a rotatable deck. This includes the horn with the attached vertical guide, the A-frame at right angles to the horn and supporting it against side loading, and also the shock absorber. The deck rests on five wheels riding on a circular rail on top of the cylindrical portion of the tower. Overhanging bearings and another set of wheels below, riding on an inverted rail outside the cylinder, prevent the deck from overturning. A center pintle and bearing provide for side loads.

The horn guide is pinned to the vertical guide just above the top deck and pivots on these pins against the compression of the tubular telescoping shock absorber, which extends from the top of the horn down to the deck.

A 7½-hp. motor on the deck serves to rotate the mechanism and is controlled electrically by manual or automatic switches. In the latter case, two units are provided: One to control and rotate the guide when

the ship yaws more than 7 deg. either way while riding to the side of the tower, and another to do likewise when the ship yaws more than 15 deg. while at the top of the tower.

To insure verticality of the long guide in traveling, the power to rotate it is distributed at two points; one directly below the top deck and the other just above the portal. Spur or ring gears on the tower mesh with pinions mounted on the guide and driven through a long, high-speed shaft and reduction units by the motor on the top deck.

Service Facilities—Access to the top is by either a ladder or an elevator having a speed of 200 ft. per minute. Water is supplied at the top at 50 gal. per minute through a 2½-in. pipe by a plunger pump with 7½-hp. motor. Ample water supply for rapid emergency ballasting is insured by a 10,000-gal. supply and storage underground tank fed from the city supply.

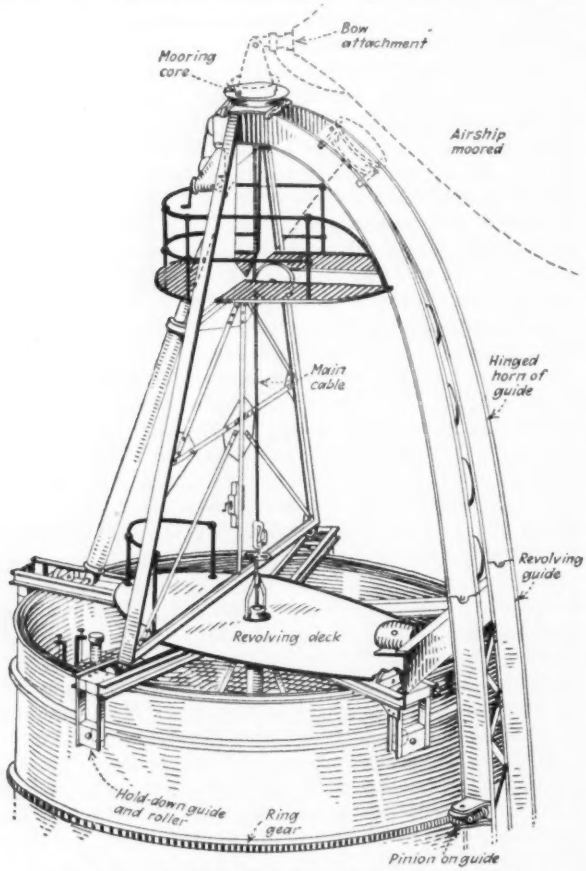


FIG. 3—REVOLVING DECK AT TOP OF TOWER

Gasoline is supplied at the top of the tower at the rate of 35 gal. per minute through a 2-in. pipe by means of a rotary pump with 5-hp. motor. A 6-in. pipe conducts helium or hydrogen gas from cylinders on the ground to the top of the tower. Electric leads for a battery charging outfit as well as telephone and electric light circuits are provided at the top.

Control Methods—An elaborate electrical layout represents the latest development of mooring winches and power control. The 23,000-volt alternating current is transformed and rectified by oil transformers and a motor generator set to 220-volt direct current, this is desirable for better speed control of the winches.

Control apparatus for the main haul-in cable, which has several new features for airship mooring, is such that the ship cannot be subjected, through the main haul-in cable, to a force greater than a predetermined and adjustable amount. With excessive load or tension in the line, the cable pays out and thus relieves the load. If the cable slackens, the winch drum speeds up and recovers the slack. This latter operation is obtained through the series characteristics of the motor, while the former is obtained by a floating worm in the winch drum power drive. This worm is positioned by adjustable springs and the slight reciprocating motion of the worm under varying loads actuates the power drum controller. The winch develops at the full duty load of 50 hp. about 16,000 lb. at 80 ft. per minute. Rheostatic control provides slow hauling speeds as low as 6 ft. per minute. The slack line speed is 200 ft. per minute. An automatic spooling device provides for laying the rope evenly on the drum. Automatic as well as manual control is provided.

The two yaw-line winches handle the guy lines leading through field snatch blocks at the yaw-line anchors and thence to the bow of the ship. These winches have push-button electric control, non-automatic. Each winch, with its 35-hp. motor, has a duty load of 5,000 lb. line tension at 200 ft. per minute. All mechanical parts of the winch are designed for 10,000 lb. and the motor will be capable of withstanding overloads momentarily up to this amount if necessary. Rheostatic control allows a creeping speed of 20 ft. per minute.

Two control positions are provided, one in the machinery house and the other a remote-control station at the top of the tower. The latter enables the mooring master to have control of all the winches, while he has complete visual observance of the ship as well as of the yaw-line ground parties and the entire field.

For lighting the tower, lamps and reflectors throw a beam on each of the three legs. The yaw blocks are lighted by four 1,000-watt lights mounted on a portable truck and placed on the roof of the machinery house. Each of these lights throws a beam of light through an arc of 180 deg. horizontally and only 3 deg. vertically. One light alone enables newspaper print to be read at the yaw blocks, 625 ft. away. Alternate bands of chrome yellow, black and white paint give a high degree of visibility to the tower in clear as well as in foggy weather. The yellow stands out well in fog.

Design of Tower—This mooring tower is designed to resist a wind loading of 45 lb. per square foot of exposed projected area (equivalent to a wind of 100 miles an hour), or a 16,000-lb. ship load and a loading of 30 lb. per square foot (equivalent to a wind of 80 miles an hour). The top horn and carriage is designed for a 16,000-lb. load at any angle, horizontal or vertical.

The steelwork was fabricated and erected by Whitehead & Kales, Detroit. The foundations, built by the Austin Co., are designed for a unit pressure of 3,000 lb. per square foot. The Ford Motor Co. built the operating mechanism in its shops and also built the machinery house at the base of the tower. The general method of mooring, and certain design details of which the writer is the inventor, are covered by patents held by the Aircraft Development Corporation, Detroit, which concern acted as general contractor and supervised all of the development and construction work.

Commission Proposes Rapid-Transit Relief for North Jersey

Interstate Loop to Cost $194,000,000 Would Be First of Five Lines—Would Knit Area Within 15-Mile Circle

FIVE lines compose the rapid-transit system which is proposed in the report of the North Jersey Transit Commission, issued Jan. 15. The total mileage in this system is 130.8, but as several parts of lines operate over the same tracks, the net new mileage which it is proposed eventually to construct is 82.6. The territory that the proposed system would serve is practically all within the 15-mile circle of the metropolitan district, therefore as close to City Hall, Manhattan, as many of the outlying parts of that borough.

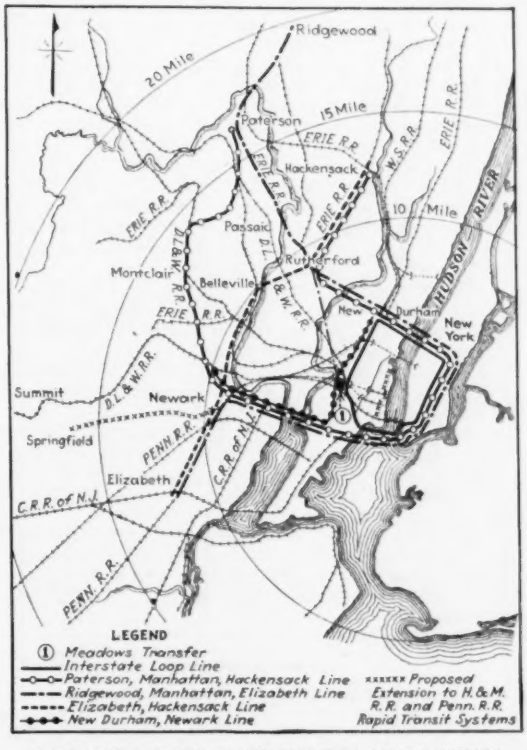
The five units in the system are as follows: 1—Interstate Loop Line, from Meadows Transfer to the Jersey Central Station, the Battery, up through Manhattan, west to 57th St. under the Hudson River to New Durham, and back to Meadows Transfer, and return; 2—Paterson-Manhattan-Hackensack Line, from Paterson through Montclair, Newark, Jersey Central Station, to the Battery, up through Manhattan to 57th St. and under the Hudson to New Durham, Rutherford, Hackensack and return; 3—Ridgewood, Manhattan-Elizabeth Line, from Ridgewood through Paterson, Passaic, Rutherford, New Durham and under the Hudson to 57th St., then down through Manhattan to the Battery, thence to the Jersey Central Station, Newark, Elizabeth and return; 4—Elizabeth-Hackensack Line, from Elizabeth through Newark and Rutherford to Hackensack and return; and 5—New Durham-Newark Line, from New Durham through the Meadows Transfer to Newark.

Inasmuch as the cost of the project is so great the commission realizes the impossibility of constructing the system except by piecemeal. The first unit which it is hoped to construct is the first one above. Aside from the mileage of track there would be constructed the Meadows Transfer Station, the chief entrance point to the Interstate Loop. It would serve only as a transfer point for passengers from steam trains. The station would be located in the vicinity of the Croxton yard of the Erie R.R., on the edge of the Jersey meadows where the Erie and the Lackawanna railroads cross to pass under Bergen Hill to enter their respective waterfront terminals at Jersey City and Hoboken. At this transfer it is planned to accommodate all the passengers from the Erie, Lackawanna, the New York, Susquehanna & Western and the West Shore railroads. Pennsylvania passengers would be cared for either at Manhattan Transfer or at Journal Square, Jersey City. There would be 18 platform tracks for steam trains, each 1,000 ft. long, and nine platform tracks for rapid-transit trains, each 750 ft. long, at the Meadows transfer.

The estimated cost of this first unit is, without cost of operating equipment, $154,000,000. Equipment is figured at $40,000,000. It is estimated that 192,500 passengers could be handled each day in each direction, and at a saving of time and increase in convenience of the commuter.

The maximum fare on this loop required to meet all costs of financing the project, except rights-of-way, with the minimum traffic, would be 17 cents. With maximum traffic that would be reduced to below 12 cents. It is believed that a 15-cent fare from the beginning would soon make up any operating deficit of the first few years of operation. The project could be financed by drawing on the state and county credit, by interesting private capital in the plan, or by the benefit-assessment plan.

Lines 1, 2 and 3 (see figure herewith) would operate as through lines and therefore furnish a through service from one outer terminal, through Manhattan from the Battery to 57th St., or vice-versa, to the other outer terminal and return, just as the Interborough lines now operate from the Bronx through Manhattan to Brooklyn and return. The Interstate Loop (Line 1) alone, if all of the other lines of the system are not immediately constructed, would furnish the commuters from both



PROPOSED NORTH JERSEY TRANSIT SYSTEM WITH UNITS COMPRISING IT

the inner and outer rings, or from the entire North Jersey area, through Manhattan service from the Battery to 57th St.

Line 4 would provide a cross-country service connecting Lines 2 and 3 at about their center points in the North Jersey area, and pass through Newark, the population center of the area. Line 5 would provide Jersey City and the Bergen County Palisade section with convenient access to Newark.

The cost of constructing the entire system has been roughly estimated at $260,000,000 of which about $130,000,000 represents the Hudson River tunnel crossing and line construction in Manhattan. The 72 miles in Jersey it is estimated could be built at about $1,810,000 per route-mile. To equip the entire system, exclusive of power, would cost about $122,000,000.

Emergency relief is recommended by the construction of a Battery tunnel first, by connecting with the East and the West side lines of the Interborough.

The report is the work of Daniel L. Turner, consulting engineer, and Charles N. Green, chief engineer of the North Jersey Transit Commission.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Income Tax Test Suit Brought by Committee of American Institute of Consulting Engineers

Sir—I note with interest the editorial in your issue of Jan. 21, p. 102, on the Supreme Court decision in regard to the income tax as applied to municipal earnings of consulting engineers. It may be proper to add that this was a test case brought by a committee of the Institute of Consulting Engineers. This committee, consisting of John W. Alvord, Harrison P. Eddy, F. A. Molitor and the writer with Philip Nichols of Boston as attorney, was established in 1921 for the purpose of ascertaining conditions and doing what was possible to improve them in this difficult field.

In the early years of the income tax, members of the Institute had been instructed upon inquiry that a broad interpretation would be given to the exemption provision, and as far as we are aware no engineers were required to pay taxes on such earnings before 1918. Thereafter the taxes were larger, and collectors in some cases held that the exemption did not apply. Private inquiries in 1921 by the committee indicated that about half of the members of the Institute were then paying tax on this kind of income, while others were not required to pay.

The Institute at its annual meeting in 1922 voted, first, to favor the equal taxation of all incomes without any exemption to municipal incomes; and second, that if for constitutional reasons exemption must be allowed, that the law be made definite and certain. Following this meeting several test cases were started, one of which has been carried to the Supreme Court as recorded in your journal. Costs of this work have been met by subscriptions from thirty-five engineers, most of them members of the Institute.

If the uncertainty has not been entirely removed by this decision, it has been greatly reduced; and we think that the result is well worth what it has cost. ALLEN HAZEN.

New York City,
January 25, 1926.

Speed of Moving Sliding Forms

Sir—I have been reading with interest the articles in *Engineering News-Record* of Nov. 12, 1925, p. 786 and Dec. 17, p. 1,007, especially with reference to the speed of moving sliding forms. In the letter of D. W. Shearer of the Carter-Halls-Aldinger Company, he speaks of 14 ft. 1 in. in 24 hours as being a record. In view of the above, we trust we may be pardoned for calling your attention to the following:

In *Engineering News-Record* Aug. 26, 1920, p. 388, you printed a comprehensive article on some concrete ships which we built at Arkansas Pass, Texas. These ships were built in sections, the sections being poured continuously by the use of sliding forms, and on p. 389 of this issue you will notice the statement that one of these sections, 26 ft. 10 in. high, was poured in 28 hours. It would probably be the contention of Mr. Shearer or Mr. Egelhoff, who wrote the article in the Nov. 12 issue, that this record is unusual and was accomplished only because these sections were of small diameter and were being built on a production basis. It would be only fair to point out, therefore, several instances where remarkable speed with sliding forms was obtained under the ordinary construction conditions that confront specialists in this type of construction in different parts of the country.

On a job in Missouri, we built some bins 30 ft. in diameter by 35 ft. high. These walls were run in two days, or at an average of 17 ft. 6 in. in one day. On other work, in Wisconsin, the same record of 17 ft. 6 in. per day was obtained on bins 28 ft. in diameter and 35 ft. high.

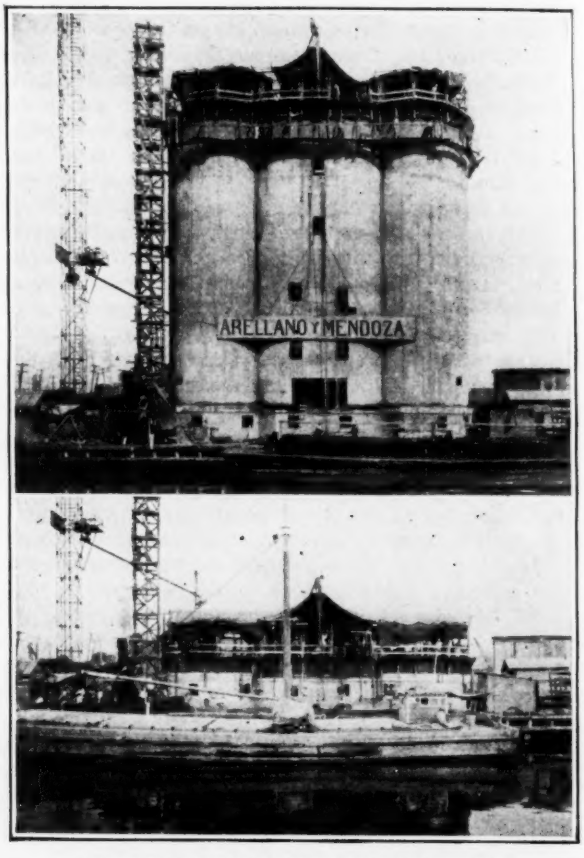
At Havana, Cuba, we built some silos 32 ft. in diameter by 80 ft. high. The bin walls on this job were started at 9 a.m. on Monday and on Friday at 6 p.m. of the same week, the concrete had been poured the full height of 80 ft. for a daily *average* over the 4½ days of 18 ft. per day. The job was run in two shifts of 10 hours each.

While several of the items pointed out by Mr. Egelhoff as being factors required for high speed in moving form work, it is apparently necessary to have, in addition, a highly efficient lifting jack and a competently designed form.

Chicago, Ill., MACDONALD ENGINEERING CO.
Dec. 23, 1925. James W. MacDonald, Secretary.

Speed of Moving Sliding Forms in Cuba

Sir—In reference to record in your issue of Dec. 17, 1925, p. 1007, we have recently built for the Cuban Portland Cement Corp., two silos 32 ft. in inside diameter with 8-in. walls and two connecting walls each 33 ft. long joining silos, one starting at the bottom and the other starting at an elevation of 42 ft. For the latter it was necessary to bring up falsework on which to start the concrete. This falsework delayed the work at least six hours.



FIVE DAYS' WORK WITH SLIDING FORMS
Lower picture taken July 20, 1925 and the upper picture July 24, 1925.

The mixer was started at 9.30 a.m. July 20 and the last concrete placed at 4 p.m. July 24. The mix was 1:2:4 with 21 gal. of water to 16 cu.ft. of mix. The time of mixing was 3 to 4 min. No vertical steel was used except jack rods and around openings.

Two shifts were employed: 7 a.m. to 6 p.m. and 7 p.m. to 6 a.m., with one hour for lunch at noon and midnight, a few men remaining on the jacks during meal hours and between shifts.

Large tarpaulins covered the working platform. Temperature averaged day in shade 96 deg.; night about 82 deg. Trade winds prevailed during day from 8 a.m. to 5 or 6 p.m.; night winds from land from 8 p.m. till 4 or 5 a.m.

Labor was Spanish or Cuban, who had never seen a silo before. One boss carpenter was sent from the United

States to superintend form construction and one Spanish foreman in charge had seen some silos built and had used jacks on construction of walls for bucket elevator.

More work was accomplished at night due to less interference from visitors and no steel to get up as this was hoisted by the day gang. There were not ten equare yards of patching on the whole job. Masons just floated walls on outside under forms. Trap rock was used. Sea sand, composed of coral and shells was used as dredged from Gulf of Mexico. The cement was made in Cuba by owners. Forms were 4 ft. high.

We enclose photos, one taken one hour before start and the other 7½ hours before the finish. Four hours could have been saved if we had not stopped to "bolt off" but instead carried forms to top and suspended forms from top of concrete, which we finally did as simpler and better.

The work done each day was as follows:

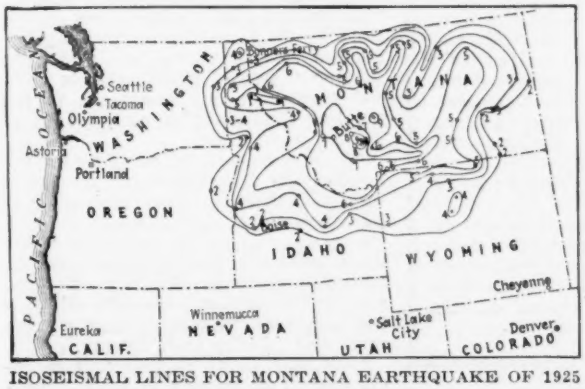
	Record by Gangs		
	Day	Night	Total
July 20	7 ft. 3 in.	8 ft. 9 in.	16 ft. 0 in.
July 21	8 ft. 11 in.	11 ft. 8 in.	20 ft. 7 in.
July 22	7 ft. 8 in.	9 ft. 11 in.	17 ft. 7 in.
July 23	10 ft. 5 in.	9 ft. 4 in.	19 ft. 9 in.
July 24	6 ft. 9 in.	finished	6 ft. 9 in.
Total			80 ft. 8 in.

Arellano y Mendoza,
By C. C. FitzGerald,
Engineer.

Habana, Cuba.
Dec. 30, 1925.

Seismological Records Kept Up by Coast Survey

Sir—In the excellent article on "Earthquake Expectancy in California," by Henry D. Dewell in your issue of Jan. 21, p. 114, there appears a statement which shows that Mr. Dewell is not informed in regard to the plans of this bureau in seismological work.



ISOSEISMAL LINES FOR MONTANA EARTHQUAKE OF 1925

His statement is: "Unfortunately Congress in transferring the seismological service to the Coast and Geodetic Survey made no appropriation of funds, and the record has lapsed during the year and a half of greatest interest to the country."

As a matter of fact, even though no funds have been appropriated which permit the extension of the seismological work of the Coast and Geodetic Survey, there has not only been no lapse in the record, but it is more complete than before. A series of quarterly publications has been started and that for the first quarter of 1925 will be issued very soon and the others will follow at suitable intervals. There has been considerable delay owing to conditions beyond the control of this bureau, but it is believed that when the publications are received they will be found to meet the needs for information, during the period referred to by Mr. Dewell, quite adequately. I may say that the publication for the second half of 1924 has not yet been prepared, but it too will be forthcoming in due time.

As an ilustration of the fact that the Coast and Geodetic Survey has been active, I enclose a copy of the isoseismal lines for the Montana earthquake of 1925.

E. LESTER JONES,
Director, U. S. Coast and Geodetic Survey.

Washington, D. C.,
Jan. 28, 1926.

Some Words for Y Sewer Connections and on Connections in General

Sir—The letter by Alexander Potter, in *Engineering News-Record*, Dec. 24, 1925, p. 1043, concerning the relative advantages of Y and T-branches for sewer connections is very interesting. Although Mr. Potter sets out plainly the general advantages in using Ts in lieu of Ys, yet each type of special has advantages over the other, and there are conditions where one, on account otf its special fitness, should be used in preference to the other.

In the maintenance of small pipe sewer lines, the Y-branch with the usual curves and bends has a distinct advantage in safeguarding the sewer from damage. When a plumber is called to unstop a house connection and is unable to pass through the line a flexible wire or cable, his next resource is to use a rod, jointed, or otherwise, to dislodge the stoppage. While the flexible cable or wire will do little, if any, harm, if it is forced through into the main line sewer the rod may do considerable damage. Assuming that a T-branch has been used, the first real obstruction that the plumber may meet when using the rod is the wall of the main sewer opposite the branch. If he assumes, as he usually does, that he has reached the seat of the trouble and by forcing tries to pass the obstruction, the result is a puncture in the side of the main sewer. If the branch from the main sewer has been made with a Y instead of a T, and one or more bends have been used in connection with it, the rod will bind in the bend of the pipe and resist being forced into and through the wall of the main sewer. This is a sufficient advantage, so that in the sewer codes of certain small towns the requirement has been introduced that where service connections are joined directly to the main sewer a Y-branch with bends shall be used in all cases except when connection is made to a chimney.

In cases where the main sewer is deep, it is surely the best practice to use T-branches with a chimney extending vertically from the main sewer, to not more than 6 ft. below the street surface, the special in the main sewer being reinforced with concrete. These chimneys allow two house connections to be made to the same outlet and greatly reduce the cost to the abuttors for their sewer connections.

It is a great advantage to specify that a 2x2 or 2x4 in. scantling be placed vertically adjacent to each branch and extended to within about 10 in. of the street surface. If the plumber in excavating finds the top of this marker, it is very easy for him to follow it downward to the branch, often at a saving of considerable unnecessary excavation.

As to the proper placing of branches on small pipe sewers on residential streets, the rule used by S. R. Curtis, superintendent of sewers of Newburyport, Mass., thirty years ago, has been found to be useful. It is as follows: Place a Y-branch 5 ft. beyond the line of each vacant building lot as the sewers are constructed along the streets. If the lot is more than 60 ft. wide place another branch 25 ft. from the first. If the lot is occupied by a house and no special instructions can be obtained from the owner where a branch is desired, place a branch about 3 ft. before reaching the line of the house extended and if the house be a double one, another branch opposite the center of the house. Branches placed in accordance with the above rule will average about 40 ft. apart on each side of the sewer in the usual residential section of the smaller towns.

A method which has proven very successful in placing the vitrified stoppers in branches left for future connections may be mentioned. It is desirable that the branch be water tight and yet be removed without danger of breaking the bell of the branch when a connection to the sewer is to be made. These requirements can be met by filling compactly around and over the stopper with clay moistened and kneaded to the consistency of putty until the entire bell is filled to within ¼ in. of the top. The remainder of the bell is filled with 1 to 1 cement mortar, using coarse sharp sand. The branches should be prepared two or three days before being laid so that the mortar cover will have sufficient time to set. When it becomes necessary to make a connection to a branch, the mortar coat can be broken and the stopper removed without damage to the bell of the branch.

C. L. B. ANDERSON,
Lieut. (C. E. Corps) U. S. Navy.

Naval Operating Base,
Hampton Roads, Norfolk, Va.,
Jan. 22, 1926.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

License Law High Spot of Iowa Meeting

Iowa Engineers Plan Defense of State License Law—Highway Work Discussed

Certain architects doing work in Iowa have attacked the engineers' license law. Plans for a Shrine Temple have been submitted to the Des Moines building department without the seal of a registered engineer. The department has refused a permit and appeal has been made to the attorney general for a ruling. Briefs from the engineers are requested. The architects have already submitted one. Apparently the controversy arises over the definition of what constitutes engineering and what architecture in a building. The law does not specifically cover buildings but has a term "structural works" which the engineers claim refers to the structural portions of a building. The Iowa Society of Engineers in session at Mason City Jan. 27, 28 and 29 instructed its committee on legislation to prepare a brief, engaging such assistance as necessary for which an appropriation not exceeding $200 was authorized.

John Dunlap Award

Other actions taken include the establishment of the John Dunlap annual award of a suitable certificate to that member each year who has rendered distinguished service to the society and the profession. Approval of a plan to co-operate with the Illinois and Wisconsin Engineering Societies in issuing the proceedings in quarterly volumes by a single printer thereby obtaining second class postal rates; approval of the State Board of Health activity in making its stream pollution surveys, of the 3-year highway program of the State Highway Commission; and presentation of junior memberships to prize winning students in the engineering schools of the states.

Round Table Discussion

Eighteen papers were presented in addition to discussions at four round-table section meetings. Of special note in the highway field was a paper on road failures in northeastern Iowa by Prof. Q. C. Ayres, Iowa State College, giving the cause of the development of soft spots. Four hundred and forty-four test holes 12 ft. deep were dug in 1925. The general conclusion was that the weathered crust had been removed to unstable material consisting of unweathered loessal clay.

Iowa good roads boosters are working on an $80,000,000 bond issue program which is 9 years off but by a 3-year program explained by Fred P. White, state highway engineer, the through routes can be connected up by paving 436 miles, graveling 2,730 miles and grading 1,104 miles at a cost of $27,900,000 which can be raised.

P. H. Elwood, landscape architect, Iowa State College, presented a paper on planting highways taking into account snow drifting and the character of the surrounding topography.

W. G. Raymond, dean of engineering University of Iowa, presented a new and ingenious road taxing method lifting the burden from real estate and putting it entirely on the road user.

In the drainage field Charles E. Gross, drainage engineer, Eagle Grove, explained two successful examples of preventing stream erosion by the use of woven wire and straw mats. C. H. Young, consulting engineer, Muscatine, explained the methods of presenting data to the courts in the Illinois Valley flood damage cases against the Sanitary District of Chicago.

George H. Herrold's paper on "City Planning Accomplishments in St. Paul"

(Concluded on p. 211)

Engineering Fifty Years Ago

From *Engineering News*, February, 1876

CAPTAIN EADS, in a recent letter, speaks very encouragingly of the success of his system of jetties, as shown by what they have already accomplished. He says that since the 1st of October, 1875, more than one million and a quarter cubic yards of sand have been scoured away by the accelerated current, and that this amount is more than one-third of the quantity which must be swept away in order to give the required twenty feet of water at low tides on the bar. He adds that "The concentrated and accelerated outflow of the river sustains its suspended load to greater distances in the Gulf than ever before, and the prevailing westerly sea current, which is induced by the prevalent east winds, bears the river water thus laden westwardly and into deeper water, and entirely away from the jetties." Captain Eads received a despatch on Feb. 7th, from Colonel Andrews, the contractor for the jetties at the mouth of the Mississippi River announcing thirteen feet of water through the crest of the bar at South Pass, being an increase of three feet in the past eight days. Seven feet additional water will entitle Captain Eads to the first payment, by the terms of the grant from Congress.

U. S. Chamber of Commerce Denounces Day Labor

Favors Contract System as More Economical and as Leading to Better Results

The growing tendency of public officials to expend public funds for construction work by the day labor rather than by the contract system is denounced by a special committee of the Chamber of Commerce of the United States in a report made public Jan. 28. The report is submitted by Joseph H. Defrees, Chicago; Arthur S. Bent, Los Angeles; John M. Crawford, Parkersburg, W. Va.; Clyde C. Dawson, Denver; and Sylvester L. Weaver, Los Angeles. It will be considered by the national body at its annual meeting in May.

Amount of Day Labor

Of approximately $2,000.000,000 expended annually for public construction, the committee estimates that $300,000,000 is expended by public officials themselves by the day labor method.

"The day-labor method in public construction," the committee asserts, "means that public officials not chosen for office because of their training and success as construction managers, assume charge of great projects without furnishing any guarantee to the paying public of either cost, quality or time of completion.

"It is a menace to quality of work because the designing department, the inspection department and the construction department are in effect one and the same. There is no disinterested check upon changes in plans, methods, materials or labor efficiency. Responsibility for costs and the duty of passing judgment on quality cannot properly repose in the same agency.

"The day labor method fosters inefficiency and laxness in labor. Payrolls are likely to be excessive, and it is common knowledge that the lowest man-hour output is to be found on public work done by day labor.

"Under the day labor method taxpayers have no assurance that the money they provide by bond issues, assessments or taxes will ultimately produce the proposed structure. No surety bond guarantees such a project and no public official or body ever assumes any financial responsibility. When the money is gone, Congress or the people are asked for more.

Contract Work Better

"In general, construction work is done better in less time, and at lower cost, by the contract method. Better, because workmanship and quality of materials and even methods are subject to the rigid inspection and supervision of the owner. In less time, because definite time limits are fixed in every contract and penalties are provided for delay. At less cost, because

the work is awarded to specialists under open competition, and guarantee of completion for the sum bid is furnished by a surety bond.

"The contract system is based upon well established economic principles. Its fundamental characteristics are public competition, responsibility, skill, protection of the public against losses through accidents, floods, fires and storms, guaranteed time limits, guaranteed costs, preservation of individual initiative, and the stimulation of the resourcefulness necessarily developed by competition. The development of this system has made America foremost in labor-saving equipment and economical construction methods."

The committee recommends that plans and specifications for public works should be prepared in advance and filed as a permanent public record, that public estimates should be made of the cost, that competitive bids should be sought and also made a matter of public record for future reference. It also recommends the establishment of an accounting system showing accurate and complete costs to apply whenever work is done by day labor and that on completion of the work itemized statements should become public records.

Pennsylvania Senate Approves Bridge Tolls Plan

The Pennsylvania State Senate, on Feb. 2, voted 37 to 1 in favor of a bill repealing the law of last year and establishing tolls on the Delaware River Bridge at Philadelphia.

The bill provides for continuance of present commission in charge of the bridge instead of the bridge control board which was created by the former law and provides that Pennsylvania shall receive four percent interest on the money invested in the bridge. It is expected that the House will pass the bill this week and the Governor will sign it at once. Contracts for completion of the work probably will be advertised next week for bids early in March.

Advise Changes Before New Jersey Aprroves Water Compact

Changes in the proposed Tri-State Delaware River Compact before its approval by the New Jersey Legislature are advised in a special report of the Water Policy Commission created by the 1925 Legislature. The compact has been approved by the New York Legislature and is now before the special session of the Pennsylvania Legislature. The commission has yet to report on a water policy on internal water supply problems. Carroll P. Bassett, Summit, N. J., is the only engineer on the commission. Nicholas S. Hill, Jr., New York City, made the engineering studies for the commission.

Cincinnati Club Joins Council

After considerable discussion the Engineers' Club of Cincinnati has voted to become a member of the American Engineering Council. It was represented at the January meeting of the council by John E. Doran, newly elected president of the Club.

Illinois Engineers Discuss Technical Affairs

Licensing Surveyors—State Control of Water Supply—Many Other Subjects

State control of public water supply was the subject of animated discussion at the annual meeting of the Illinois Society of Engineers, held at Elgin, Ill., on Jan. 26 to 29. The occasion was an address by H. F. Ferguson, chief sanitary engineer of the State Board of Health, in which he reviewed four epidemics in Illinois during 1925, all due to pollution of drinking water. He took the position that water supply is not merely a local matter, since persons infected at one place may spread disease in other places. The State Board of Health may make recommendations as to the improvement of dangerous conditions, but the cities concerned do not always heed the recommendations. Another subject in the water-supply section was "The Yield of Wells," with methods of measuring water level and flow, by G. C. Habermeyer and C. V. Swearingen, of the State Water Survey. A project for the supply of lake water to a number of suburban and residential towns within 50 miles of Chicago was described by Charles B. Burdick, Chicago.

A feature of the meetings of this society is that each of its technical sections is assigned a part of the time, with its chairman presiding, so that the sections and their chairmen have a very definite part in the proceedings. In his opening address, the president, A. L. Webster, Wheaton, remarked that in spite of the great advances in engineering development in recent years this is still the "age of opportunity," since greater advances are ahead. An interesting economic development was the approval by the society of a tentative plan for joint publication of the "proceedings" of the Illinois, Iowa and Wisconsin societies. J. J. Woltman, Bloomington, Ill., was elected president; W. D. P. Warren, Decatur, vice-president. H. E. Babbitt, Urbana, is secretary. The next meeting will be at Springfield, Ill. About 150 members and guests were registered.

At the drainage session, malaria and mosquito control work in Illinois was reviewed by J. L. Clarke and A. F. Dappert, assistant engineers of the State Department of Public Health. This work included drainage and the clearing and oiling of wet spots, both in open country and in the vicinity of cities. Probably a score of towns have carried on control work of some kind. H. E. Babbitt warned of oiling as possibly destructive of waterfowl, vast quantities of birds having been killed owing to the oily film on water. Features of drainage projects on streams with only 100 to 300 sq.mi. of drainage area were described by C. A. Sheppard, Edwardsville.

The surveying and city planning session had an extended discussion of the zoning and planning problem and its various aspects, more especially in regard to the fact that very little compulsion can be exercised. The Chicago regional plan for coordinated improvements within a 50-mile circle was outlined by Robert Kingery. Two modern cases of comprehensive planning free from restrictions were noted by E. E. R. Tratman, of *Engineering News-Record*, these being the "official" or governmental cities of Delhi, India, and Canberra, Australia, the latter planned by an American architect. In both cases the site of the new city was open country. Methods used in the cooperative survey of Illinois by the U. S. Geological Survey and the Illinois Geological Survey were described in a paper by Major W. H. Herron.

Two legislative matters were considered. A resolution was adopted protesting against the proposed reduced appropriation for the topographical survey of the country and urging Congress to make sufficient appropriation to carry out the plan under the Temple Bill, with a view to its completion in twenty years. It was noted that failure of a state bill for the licensing of all surveyors, as an enlargement of the present law which applies only to Cook County (Chicago), may lead to the preparation of a modified bill applying to all Illinois counties of more than 100,000 population.

At the roads and pavements session, economic value of steel reinforcement in concrete paving was discussed by H. Elting Breed, New York, who exhibited numerous charts showing the relative freedom from cracks in such paving as compared with plain concrete. Important results of highway research work by the U. S. Bureau of Public Roads were reviewed by A. T. Goldbeck, and the results of tests of brick paving 2- to 4-in. thick were presented by John M. Egan, while the construction and maintenance of penetration-macadam paving was described by Geo. E. Martin. These last authors are engineers representing the crushed stone, paving brick and asphalt industries respectively.

Several special features in sewage treatment were noted in a series of papers at the sewerage session. Starch wastes are a factor at Argo and Decatur, Ill.; and heavy proportions of packing-house wastes at Madison, Wis., and one of the Chicago plants, while experiments with the heating of sludge storage tanks in order to promote digestion will be made at Wheaton, Ill. Another feature of this last plant is that it is a winter construction job, the site of the concrete tanks being entirely housed and roofed. Sanitary district organization and construction at Elgin and Bloomington was also described, and an excellent description of the big Milwaukee disposal plant was given by T. Chalkley Hatton, chief engineer, with the aid of moving pictures and action drawings.

St. Louis-San Francisco Ry. Buys the Rock Island

Directors of the St. Louis-San Francisco Ry. Co., on Jan. 23, announced the purchase of a controlling interest in the Chicago, Rock Island & Pacific Ry. Co. If control of the Rock Island by the Frisco is approved by the Interstate Commerce Commission the two railroads will be merged into one system having a total mileage of 12,400.

Leonard Metcalf Dies

Distinguished Boston Engineer Passes Away After Long Illness

Leonard Metcalf, consulting engineer and senior partner of Metcalf & Eddy, Boston, Mass., died on Jan. 29 at his home in Concord, Mass., after a long illness, only the later stages of which were known except by his immediate associates and a few intimate friends.

He was born in Galveston, Texas, Aug. 26, 1870, the son of Joseph Houghton and Emma Augusta (Leonard) Metcalf. His home for the greater part of his life was in Concord, Mass. After attending the Concord High School he graduated in civil engineering from the Massachusetts Institute of Technology in 1892. For three years after graduation he was employed by Wheeler & Parks of Boston, civil engineers and operators of water companies. He then served for two years as Professor of Mathematics and Engineering at Massachusetts Agricultural College. In 1897 he began civil engineering practice in his own name in Boston; and in 1907 he formed a partnership with Harrison P. Eddy under the firm name of Melcalf & Eddy, specializing in hydraulic and sanitary engineering.

Active in Many Fields

Mr. Metcalf's outstanding professional achievements were largely in the field of municipal water-works. Besides being engaged in their design and construction he served for years as manager of both water and electric lighting plants. He took a keen interest in the financial problems of water-works properties and was almost constantly engaged in advising owners relative to betterment of economic conditions and the adoption of sound policies which would result in adequate service to consumers and reasonable compensation for such service.

The most important of his accomplishments were in the field of valuation and rate making for public utilities. Besides his testimony in rate cases he did valuable work as a member and the secretary of the Committee on Valuation of the American Society of Civil Engineers and since the Great War he made valuable studies of price trends and index numbers, particularly as affecting water-works valuation and rates. Among the most important of his engagements in valuation and rate-making cases were those for the water companies supplying San Francisco, Des Moines, Indianapolis, Utica and Paterson and other New Jersey communities. The water rate case of the Pennsylvania Water Co. of Wilkinsburg, Pa., while not of so great magnitude as some of the others, deserves particular notice because it resulted in a study of the basis of fixing rates for fire hydrant service, which has generally been accepted as the most significant and authoritative discussion of the matter which has ever been presented. His writings on these and related subjects, published mainly in the *Journals* of the American and New England Water Works Association and the *Transactions* of the American Society of Civil Engineers and in the recently issued "Manual of American Water Works Practice," bear witness to the logic and accuracy of his conclusions, and of his desire to make such material available to the profession rather than to hold it for his personal use.

Besides the many water rate cases and water-works improvements in which Mr. Metcalf was employed, he was engaged on water-works and sewerage and he made important studies of municipal efficiency for the original Boston Finance Commission (1907-1908). During 1925 he was consulting engineer to the Metropolitan Water Supply Investigating Commission of Massachusetts.

Public Service

For several years Mr. Metcalf served the Town of Concord as a trustee of the public library, and since 1915 as a member of the Board of Water and Sewer Commissioners, of which he was chairman from 1917. His interest in his Alma Mater, the Massachusetts Institute of Technology, was constant. He had been president of the Alumni Association and was a member of the Corporation of the Institute at the time of his death.

When war was declared in 1917, Mr. Metcalf was appointed as member of the sub-committee on Emergency Construction of Buildings and Engineering Structures, under the National Council of Defense—the committee which assisted General Littell in establishing the Construction Division—and aided in selecting personnel, making out forms of contract, providing lists of contractors, selecting cantonment sites, and awarding contracts for the cantonments erected during the summer of 1917 for the new National Army. The members of this committee were civilians. They were men who had made their mark in civil life, and whose decisions upon certain matters could not be questioned. They determined policies, and gave the military authorities the necessary moral backing to carry these policies through. This was necessary, for in the case of cantonments, and many other projects, work had to be started before it was possible to obtain the necessary funds.

Professional Service

Mr. Metcalf's services to the profession of civil engineering have been noteworthy. He held membership in many professional societies, in most of which he had served on various committees, and as an officer. He was a member of the American Society of Civil Engineers, of which he had been Director and Vice-President; the American Society of Mechanical Engineers; the Boston Society of Civil Engineers, of which he was President in 1919; the American Water Works Association, President 1916-17. After long membership in the New England Water Works Association he became its President in 1915 and was made an honorary member in 1925. He took the initiative and was instrumental with others in the bringing together of various professional engineering societies into The Affiliated Technical Societies of Boston, immediately following the war, feeling that this would lighten their financial burdens and make more effective the work of the engineer.

He was justly proud of the contributions of his office to the technical field in which he had worked, particularly of its three-volume treatise on "American Sewerage Practice," and of the one-volume abridged edition, "Sewerage and Sewage Disposal" which is now used in upwards of sixty universities and colleges in this country.

Among the most important of the papers contributed by Mr. Metcalf to technical societies are: For the American Society of Civil Engineers, "The Antecedents of the Septic Tank," "The Groined Arch as a Covering for Reservoirs and Sand Filters"; "Water-Works Valuation and Fair Rates in the Light of the Maine Supreme Court Decision"; "The Going Value of Water-Works" (with John W. Alvord); "Final Report of the Special Committee [of which Mr. Metcalf was chairman] to Formulate Principles and Methods for the Valuation of Railroad Property and Other Public Utilities."

For the American Water-Works Association, parts of several chapters in the "Manual of American Water Works Practice," 1925; "Some Fundamental Considerations in the Determination of a Reasonable Return for Public Fire Hydrant Service" (with Kuichling and Hawley); "Some Practical Checks on Water-Works Depreciation Estimates"; "Experiences with Ice in Standpipes"; "The War Burdens of Water-Works"; "The Improved Financial Condition of Water-Works."

For the New England Water Works Association, "Depreciation in Water-Works"; "Echo Lake Dam at Milford"; "Wrought-Iron Cement-Lined Pipe"; "Data on Awards for Water and Water Power Diversion" (report of a committee of which Mr. Metcalf was secretary).

Armour Institute and Northwestern Combine Forces

An important event in engineering educational affairs is the adoption of specific plans for the merger of the Armour Institute of Technology with Northwestern University, which has been effected in order to establish a large Chicago engineering school. A contract effecting this combination, under the name of the Armour College of Engineering of Northwestern University, was signed Jan. 13 by Dr. Howard M. Raymond and Dr. Walter D. Scott, presidents of the two institutions respectively. The agreement provides for the enlargement of Swift Hall of Engineering at the University and the construction of a machinery hall and two science buildings, all at Evanston, Ill., together with an engineering hall in Chicago for the accommodation of part-time students. For these and other improvements it is planned to raise a building and endowment fund of $10,000,000 by 1930. The actual consolidation will take place at the end of this five year promotion period. The number of engineering students at present is 744 at Armour Institute (with 781 evening students in addition) and 187 at Northwestern University.

Concrete Institute to Meet in Chicago Feb. 23-26

Wide Variety of Papers Listed on Design, Construction and Results of Tests

The 22nd annual convention of the American Concrete Institute is to be held at Chicago, at the Hotel Sherman, Feb. 23-26. Besides the various committee reports, there will be numerous papers on various subjects.

One of the chief items of interest on the program is the presentation of a paper on reinforced-concrete track supports by Frank H. Alfred, president and general manager of the Pere Marquette Ry. There will follow a discussion on this paper in which a number of railway engineers have been invited to participate. The general subject of the discussion will be railroads and concrete, and participants in it will attempt to answer the question: "Just how far have the railroads gone in a progressive attitude toward modern design and construction with concrete?"

The session Tuesday evening, Feb. 23, will feature a question box, in which time 10 questions concerning field methods principally will be featured.

Concrete from architectural and craft standpoints will be discussed on Wednesday evening when John J. Earley will present a paper on the Tennessee Parthenon and the Louisiana State University group at Baton Rouge. David C. Allison, of Allison & Allison, architects, will present a paper discussing the structural principles in present-day steel and concrete buildings as differing from principles upon which traditional architecture is based. This will be followed by an address by A. O. Malone, a master craftsman in stucco, who will demonstrate on the floor of the convention the actual application of stucco in new textures. The Wednesday morning and afternoon sessions will cover the field application of quality control methods for concrete. Thursday morning will be devoted to technical aspects of concrete building units and Thursday afternoon to an inspection of work actually in progress in quality control of concrete on the Wacker Drive. At the Thursday evening session concrete floors and concrete roads will be discussed. Reports and papers bearing chiefly on test investigations will occupy the Friday morning session.

During the sessions, the following will present papers in addition to those named: Major M. C. Tyler, J. C. Evans, R. B. Young, W. S. Hindman, J. G. Ahlers, H. M. Hadley, A. Burton Cohen, H. S. Wright, Frank P. Cartwright, P. C. Cunnick, J. L. Harrison, H. S. Mattimore, L. W. Teller and J. T. Pauls, H. F. Clemmer, A. T. Goldbeck, Alfred H. White and John H. Bateman, Willis A. Slater, Dr. W. K. Hatt, Benjamin Wilk and H. J. Gilkey. The subjects which these men will present cover quality of concrete, its field control methods and results; reinforced-concrete design to resist earthquake shock; bridge design and construction; concrete masonry units; road design and construction; and tests.

Foundation Co. Begins Work on Huge Greek Reclamation Job

One of the largest foreign contracts yet started by an American construction firm is that given the Foundation Co., New York City, by the Greek government. The contract calls for the reclamation of the Salonika plain, an area of some 800 sq.mi., at an expenditure of about $35,000,000. The work is to consist in training and regulating the Vardar River from its entrance to the plain to the Gulf of Salonika, and drainage of the lakes and swamps which comprise an area of about 300 sq.in. The river control work will necessitate many miles of levees, and construction of groins and diversion works. It is estimated that 31,000,000 cu.yd. of earth will be moved, and a maximum daily average of 5,000 men employed.

Funds with which the work will be done are to be derived from a loan made by New York and London bankers, secured by the yearly surplus of the International Finance Commission, through which Greece has handled her finances for the past 20 years. It is estimated that this surplus will many times meet the service requirements of the loan. The Greek government owns all the land under water; and the value of that portion of the reclaimed area is put at a sum greater than the cost of the entire reclamation. Until the loan is issued, the Foundation Co. is advancing the money required in order that there may be no delay in prosecuting the work. Preliminary surveys are now under way.

Iowa Engineers Meeting

(*Concluded from p.* 208)

stressed the economics of city planning rather than beautification.

In the municipal section meeting discussion by Prof. E. L. Waterman, State University of Iowa, brought out the fact that pollution of the boundary rivers was becoming a pressing problem which the State Board of Health so far had considered outside of its jurisdiction and one that required concerted action of some kind with contiguous states. This problem and that of the formation of sanitary districts to avoid present financial and territorial limitations are to be studied intensively during the year.

A paper by N. T. Veatch, Jr., consulting engineer, Kansas City on the "Selection of Pumping Equipment" read by E. B. Black, described the factors that should be taken into account for various conditions.

A novel paper of value to engineering schools was that of John S. Dodds director, Ames summer camp; on the specifications, selection and development of a summer camp for engineering students so as to give them a touch of the pioneering life of the early engineer and surveyor. Prof. Dodd's paper described the camp on Rainy Lake, Minn., that leaves little to be desired from bear encounters to mosquitoe hazards.

The newly-elected officers are as follows: P. F. Hopkins, president and Prof. F. B. Lambert, vice-president. John S. Dodds, secretary-treasurer was re-elected by the executive committee.

Hoover Favors Large Inland Waterway Systems

Secretary Recommends Completion of Mississippi System and Great Lakes to Sea Route

Herbert Hoover, Secretary of Commerce, speaking before the House Committee on Rivers and Harbors on Jan. 30, expressed himself as favoring the rapid completion of the Mississippi inland waterway system and the construction of a ship channel from the Great Lakes to the sea, either by the St. Lawrence route or across New York state to the Hudson River. He feels that with the normal growth of the country we must have double our transportation facilities at the end of the next quarter century and that much of this can be provided by adequate waterways without any detrimental effect upon the railroads. In fact, Mr. Hoover thinks that the railways and waterways can be co-ordinated in such a way as to relieve the railroads of some of their future problems such as providing adequate terminal facilities in the larger centers.

The completed Mississippi system, as outlined by Mr. Hoover would have a total length of about 9,000 miles. The east-west trunk waterway would extend from Pittsburgh through Cairo to St. Louis and to Kansas City, 1,600 miles, and the north-south trunk would extend from New Orleans to Chicago and up the Mississippi to St. Paul and Minneapolis. With improvements of the upper Missouri, the Tennessee, the Arkansas and the intracoastal canal to Galveston and Houston the system would reach many more inland cities.

The Mississippi system is about two-thirds complete in disconnected sections. It could be completed in about five years at an expenditure of $100,000,000 if the work was pushed, according to Mr. Hoover's estimates.

Speaking of the outlet from the Great Lakes the Secretary said: "We know from an engineering point of view that it is entirely feasible to make every lake port an ocean port by a 25-ft. ship-way. * * * You are aware that surveys are in progress by the Engineering Corps for the determination of respective costs of the two alternate routes from the lakes to the sea, that is down the St. Lawrence or across New York State. The Department of Commerce is engaged in an intensive study of the economic phases of these routes and it is my understanding that these investigations will be complete about April 1. It does not appear to me worth consuming your time for debate on the respective merits of these routes until we have accurate facts in hand."

Plans for Tubes Under East River at New York Approved

Plans of the Board of Transportation of New York City for the construction of subway tunnels under the East River from the foot of East 53rd St., New York, to the foot of Mott Ave. in Long Island City have been approved by the Secretary of War.

Engineering Societies

Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 23-26, 1926.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Meeting, Chicago, March 9-11, 1926.

NATIONAL CONFERENCE ON STREET AND HIGHWAY SAFETY, Washington, D. C.; Second Annual Conference, Washington, D. C., March 23-25, 1926.

CONFERENCE OF STATE SANITARY ENGINEERS, Washington, D. C.; Annual Meeting, Buffalo, N. Y., June 5 and 7, 1926.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Meeting, Buffalo, N. Y., June 7-11, 1926.

The Association of Canadian Building and Construction Industries held its annual convention in Toronto Jan. 25 to 28.

The South Dakota Society of Engineers and Architects at its annual convention at Watertown, S. D., in January elected as president John Berg, state engineer; as vice-president, Dean Crothers, of the engineering department at State College; and as secretary-treasurer, W. F. Cochrane, city engineer at Watertown.

The Colorado Society of Engineers held its annual meeting, Jan. 16. The principal address was made by County Judge George A. Luxford on the work the engineers are doing for the upbuilding of Denver and Colorado, and what is necessary to make the semi-centennial celebration to be held in Denver this summer, a success. George A. Begole, city auditor of Denver, spoke of the ways and means, the relation of construction and financing. Officers elected were: F. W. Whiteside, president; Roy J. Randall, vice-president; C. M. Lightburn, secretary.

Association of State Highway Officials of North Atlantic States will hold its annual convention at Syracuse, N. Y., Feb. 17-19, 1926.

New England Water Works Association's February meeting (Feb. 9) will have an illustrated lecture on "Tampa's New Water-Works" by Nicholas S. Hill, Jr., consulting engineer, New York City.

Personal Notes

WALTER A. RICHARDS, city manager of Columbus, Ga., for the past three years, has been appointed city manager of Greater Daytona Beach, Florida. Mr. Richards went to Columbus some years before he became its city manager, as engineer on construction of industrial buildings and later was chosen for the city managership.

H. F. CLEMMER, since 1920 engineer of materials for the Illinois State Highway Department, has resigned to accept a position of road research engineer with the Solvay Process Co., Syracuse, N. Y. V. L. GLOVER, successively since 1917 junior highway engineer, office engineer, assistant road engineer and road engineer of the Illinois State Highway Department, has been made engineer of materials to succeed Mr. Clemmer.

R. E. J. SUMMERS, chief engineer, H. K. Ferguson Company, has left for Japan to supervise the start of construction of the new plant of the Nippon Electric Company at Tokio to replace the one destroyed by the earthquake. WELLS N. THOMPSON, assistant to the chief engineer of the H. K. Ferguson Company, is now in Tokio in charge of the preparation of plans for this work.

W. W. MACK, formerly acting chief engineer of the Delaware State Highway Department, was appointed secretary of the department, effective Jan. 1, 1926. C. D. BUCK has resumed his duties as chief engineer of the Delaware highway department, at the expiration of his leave of absence.

RAYMOND WHITNEY, Royal Oak, Mich., has been elected city manager of Royal Oak, where he has been for six years construction engineer for Dodge Brothers, Inc. Prior to his connection with Dodge Brothers he had eleven years' experience as an engineer, in 1916 being construction engineer on the Lincoln Motor plant. He is a civil engineering graduate of the University of Michigan.

M. C. STEUBER and associates have opened a Structural Engineering Office at 405 Fulton Building, Pittsburgh, Pa., under the name of National Engineering Services, Inc., and will engage in a general structural engineering practice with especial attention to structural steelwork designs, estimates, and details. Mr. Steuber was formerly plant engineer with the McClintic Marshall Construction Co. and more recently has been a structural designer with the Koppers Construction Co.

E. G. HUNT, for five years city engineer of Aberdeen, Wash., has resigned, and will retire from service and enter private practice, as soon as a successor is appointed. Prior to his city connection, he was for five years in the employ of the Wynooche Timber Co.

JOHN LANSDALE, valuation engineer of the Southern Pacific Ry., Texas and Louisiana Lines, has now the title valuation engineer and tax commissioner, as the offices and duties of valuation engineer and tax commissioner have been consolidated.

S. L. HENDERSON, formerly with the engineering department of the Canadian National Railways, has been appointed representative of the Railway Appliance Division, American Fork & Hoe Co. at New York. From 1909 until 1911, Mr. Henderson was with Macdonell, Gzowski & Co., railway contractors, Vancouver, B. C., and upon the dissolution of that company was for a time with the city of Vancouver on survey work for the Burrard Peninsula Joint Sewerage Commission, and then with the engineering department of the Canadian Pacific Railway at Vancouver. In 1914 he went to Alaska with the White Pass & Yucan Railway & Navigation Co., but returned the same year to enlist in the 29th Battalion, Canadian Expeditionary Forces.

Obituary

JOHN R. CHAMBERLIN, senior highway bridge engineer, U. S. Bureau of Public Roads, in District 5 at Omaha, Neb., and a member of the Committee on Concrete and Reinforced Concrete Arches of the American Society of Civil Engineers, died Dec. 15, 1925, at 49 years of age. Mr. Chamberlin was born in Rochester, Ohio, and attended the academy of Heidelberg University in Ohio and Ohio State University. In 1902 he went to South America and spent a year on the engineering corps in charge of the construction of the Cerro de Pasco Ry. in Peru; then spent three years at the Baltimore & Ohio Ry. headquarters at Baltimore. From 1905 to 1912 he was instructor and assistant professor in civil engineering at Ohio State University, and from the latter date to 1919 division engineer and chief engineer of the Ohio State Highway Department. From 1919 he spent a year as senior bridge engineer of the U. S. Bureau of Public Roads at Washington and was then transferred to District 5 at Omaha.

HAROLD RASMUSSEN, Portland, Ore., consulting engineer and president of the firm of Rasmussen, Grace & Co., Inc., engineers, died, by suicide, Jan. 14 at Portland, aged 56 years. Mr. Rasmussen was born in Norway in 1873. He served in the United States army from 1894 to 1905, then for ten years was with the Hurley-Mason Co., general contractors and builders. In 1915 the firm of Rasmussen, Grace & Co., Inc., was formed and it has done much building construction work in Portland.

ALBERT HALEN, civil engineer, whose home was in Gusher (formerly Moffat), Utah, died suddenly Jan. 6, at Vernal, Utah; his age was 74 years. Mr. Halen was born in Holland, studied engineering in schools in Holland, Germany and England, and was graduated in England. Then he came to America and did engineering work in California, in Mexico, in Washington for the Northwestern Pacific R.R., in Wyoming in the oil fields. From Wyoming he went to Salt Lake City where, connected with the state engineer's office, he made a survey of the Strawberry reclamation project. Then he went to the Uintah basin and located the townsite of Moffat. Later he was engineer for the Moffat Ditch project and the Blue Bench project, and served four years as register of the U. S. land office at Vernal.

Roster of Veteran Subscribers

Engineers and contractors who have been readers of *Engineering News-Record* for 30 years or more

A CALL was sent out for information that would identify subscribers of 25 years' continuous standing. The response was so great that in the space available in this issue there is room for the names of only the men who have been subscribers for 30 years.

The present list, therefore, is not complete. To help us to make it complete will you, if you have not already done so, advise the Editor if your subscription to Engineering News-Record has covered a continuous period of 25 years or more?

The number opposite the name in the list below is, in each case, the number of years the man named has been a subscriber.

Seth Dean, Civ. Engr., Gleenwood, Iowa. 51

George King, City Engr., Taunton, Mass. 51

John W. Berry, Miners Bank Bldg., Pittston, Pa. 50

Edmund E. Allen, Civ. Engr. & Surveyor, Olean, N. Y. 50

E. C. Jordan, Civ. & Hydr. Engr., Portland, Maine..... 50

Palmer C. Ricketts, Pres., Rensselaer Polytechnic Inst., Troy, N. Y. 50

Clemens Herschel, Civ. & Hydr. Engr., New York, N. Y. 48

George Bowers, Cons. Engr., Lowell, Mass. 48

Harry C. Heermans, Pres. and Mgr. Hoquiam Water Co., Hoquiam, Wash. 48

Emile Low, C.E., U. S. Asst. Engr., Retired, Buffalo, N. Y.... 48

C. A. Mixer, Ch. Engr., Rumford Falls Pwr. Co., Rumford, Me... 46

Henry O. Brooks, Civ.Engr., Lowell, Mass.... 45

A. H. Hogeland, Chief Engr., Great Northern Ry. Co., St. Paul, Minn..... 45

Wm. A. Pratt, Cons. Engr., Waynesboro, Va. 45

E. R. Schnable, Schnable & Quinn, Contr. Chicago 44

Elmer W. Ross, Asst. Engr., Bridge Dept., Providence, R. I..... 43

Samuel Louis Jacobson, Civ. Engr., New York, N.Y. 41

Wm. B. Landreth, Cons. Engr., Schenectady, N. Y. 41

Prof. Wm. Cain, Univ. of N. C., Chapel Hill, N. C. 40

F. W. Carpenter, Cons. Engr., Cornwall, N.Y. 40

The Champion Bridge Co., Inc., Wilmington, Ohio 40

Coplay Cement Mfg. Co., Coplay, Pa..... 40

John T. Desmond, Civ. Engr., Haverhill, Mass. 40

Judson A. Doolittle, Civ. Engr., Mt. Vernon, N. Y. 30-40

G. H. Duggan, Pres., Dominion Bridge Co., Lachine Locks, Ont., Can.... 40

C. A. Fowler, Cons. Engr., Poughkeepsie, N. Y. 40

E. E. Haskell, Dean Emeritus, Cornell Univ., Hamburg, N. Y. 40

Otis E. Hovey, Asst. Chf. Engr., American Bridge Co., New York, N. Y. 40

J. A. McKenna, Asst. City Engr., Providence, R. I. 40

W. C. Merryman, Res. Engr., Interborough Rapid Transit Co., N. Y.. 40

Lincoln DeGroot Moss, Asst. Prof. of Mech. Engng., Columbia U., New York... 40

Dwight Porter, Prof. Emeritus, M.I.T., Malden, Mass. 40

A. D. Schindler, Vice-Pres., Kings County Development Co., San Francisco, Calif. 40

William D. Sell, Civ. Engr., Charleston-Kanawha, W. Va. 40

Virginia Poly. Inst. Library 40

E. Worthington, City Engr., Dedham, Mass. 40

R. M. McDowall, Cons. Engr., Owen Sound, Ont., Can. 40

F. E. Hoskins, Engr., Erie R.R. Co., Oradell, N. J. 39

Winston Brothers Co., 801 Globe Bldg., Minneapolis, Minn. 39

F. W. Blackford, Civ. Engr., Los Angeles.Calif. 38

C. S. Coe, County Engr., Palm Beach, Fla..... 38

F. C. Finkle, Hyd. Cons. Engr., Los Angeles, Calif. 38

E. A. Hermann, Pres. Reliance Whiting Co., Alton, Ill. 38

John C. Moses, Engr. Const., Boston Bridge Works, Cambridge, Mass... 38

John M. Perham, Civ. Engr., St. Johnsbury, Vt. 38

C. T. Purdy, Purdy & Henderson Co., Monroe, N. Y..... 38

Robert Ridgway, Chf. Engr., Board of Trans. New York, N. Y..... 38

M. J. Riggs, Mgr., Toledo Plant, Amer. Bridge Co., Toledo, Ohio.. 38

Oscar A. Veazey, Paint Creek Coal & Land Co., Pratt, W. Va..... 37

George M. Warren, Hydr. Engr., U. S. Bureau of Public Roads, Washington, D. C. 37

C. D. Hill, Ch. Engr. Municipal Service, Chicago, Ill..... 36

F. D. Leffingwell, Civ. Engr., Montclair, N.J. 36½

T. J. McMinn, Civ. Engr., Bridgeport, Conn. 36

W. K. Palmer, W. K. Palmer Co., Kansas City, Mo. 36

Walter C. Parmley, Civ. Engr., New York, N.Y. 36

Henry J. Sherman, Cons. Engr., Sherman & Sleeper, Camden, N. J.... 36

Willard Beahan, Ch. Engr., Cloverleaf R. R., Frankfort, Ind. 35

J. E. Bostrite, Civ. Engr., Germantown, Pa. 35

H. K. Higgins, Asst. Engr., Alabama Pwr. Co., Birmingham, Ala..... 35

W. L. Bender, Civ. Engr., Canton, O..... 35

J. W. Beardsley, Cons. Engr., Syracuse, N. Y. 35

F. W. Dalrymple, Asst. Engr., Val. Dept., Erie R.R., East Orange, N. J.... 35

J. H. Edwards, Asst. Ch. Eng., Amer. Bridge Co., Passaic, N. J..... 35

A. D. Fuller, Civ. & Cons. Engr., Bridgeport, Conn. 35

J. E. Gibson, Comm. of Pub. Works, Charleston, S. C..... 35

John V. Hanna, Ch. Engr., K. C. Terminal R.R., Kansas City, Mo... 35

J. L. Ludlow, The Ludlow Engineers, Winston-Salem, N. C..... 35

Rudolph P. Miller, Cons. Engr., New York, N.Y. 35

Geo. H. Norton, Ch. Engr., Grade Crossing & Terminal Sta., Comm., Buffalo, N. Y..... 35

W. L. Rockwell, Chf. Engr., Hidalgo Co. Wtr. Sup. Dist., Austin, Texas 35

Prof. Elton D. Walker, Prof., Penn State College, State College, Pa..... 35

Wm. F. Williams, Commsr. Pub. Wks., Boston, New Bedford, Mass..... 35

Prof. C. C. Carter, U. S. Military Academy, West Point, N. Y..... 34

Wm. J. Carter, Pres., Carter Richards Co., Cleveland, Ohio 34

S. E. Coombs, Special Engr., N. Y. Central, New York, N. Y..... 34

J. C. L. Fish, Prof. of R.R. Engrg., Stanford University, Calif.... 34

Chas. R. Harte, Constr. Engr., The Connecticut Co., New Haven, Conn. 34

F. G. Hazard, Jr., Wakefield Water Co., Narragansett Pier, R. I... 34

Milwaukee Public Library, Milwaukee, Wis. 34

R. L. Sackett, Dean of Engineering, Penn. State College, State College, Pa. 34

Charles E. Wells, North Adams, Mass. 34

Gardner S. Williams, Cons. Engr., Ann Arbor, Mich. 34

Charles F. Berger, Civ. Engr., Edward Corning Co., New York, N. Y..32 or 33

F. H. Cubberley, City of Philadelphia, Pa., Germantown, Pa. 34

Edward J. Corcoran, Civ.Engr., Wilkesbarre, Pa. 33

Carleton E. Davis, Phila. Suburban Water Co., Phila., Pa. 33

Howard N. Eavenson, Howard N. Eavenson & Associates, Pittsburgh, Pa.... 33

Alonzo J. Hammond, Ch. Engr., J. O. Haworth, Evanston, Ill. 33

Joseph Jacobs, Jacobs & Ober, Cons. Engrs., Seattle, Wash. 33

R. P. Johnston, Clinton, N. J..... 33

George C. Mason, V-Pr.s., Hurley Mason Co., Portland, Ore. 33

Geo. Simpson, Ch. Engr., Thompson-Starrett Co., New York, N. Y.. 33

Chas. H. West, Civ. Engr., Member Miss. River Comm., Greenville,Miss. 33

Robert Hoffmann, Chf. Engr., Dept. Pub. Service, Cleveland, Ohio..... 32

J. Y. Jewett, Testing Engr., City of San Diego, Calif. 32

G. E. Johnston, Asst. Engr., L. & N. R.R. Louisville, Ky. 32

E. C. Macy, Gen. Mgr., Dwight P. Robinson & Co., Los Angeles, Calif. 32

John T. Stewart, Cons. Engr., St. Paul, Minn. 32

P. W. Ralston, Instrument Mgr., C. & N.W. Ry., Chicago, Ill..... 31

Wm. B. Bamford, Arch. & Cons. Engr., Belmar, N. J. 30

Frank R. Becker, Cons. Engr., Amsterdam, N. Y. 30

Herman R. Bliss, Secy., Tower City Iron Wks., Providence, R. I. 30

B. W. Cunningham, Cons. Engr., Common Brick Mfrs. Assoc., Los Angeles, Calif. 30

Samuel C. Curriden, The Curriden Pipe Trans., Clarksboro, N. J..... 30

F. O. Dufour, Director, Div. Civil Engrs., Lafayette Coll., Easton, Pa. 30

Robert R. Evans, County Engr., Salem, Mass. 30

W. L. Garrels, Gen. Contr., Kirkwood, Wis. 30

F. T. Gucker, Gen. Contr., Phila., Pa.... 30

L. C. Hulbard, Sen. Asst. Engr., Dept. Public Wks., Poughkeepsie, N.Y. 30

C. S. Kyle, Bridge Engineer Bur. Highways, Boise, Idaho..... 30

Wm. G. Langenheim, Struc. Engr., Chicago, Ill.. 30

I. W. McConnell, Vice-Pres., Dwight P. Robinson Co., New York, N. Y. 30

A. B. McGrew, U. S. Asst. Engr., Pittsburgh, Pa. 30

Harry J. Morrison, Sr. Hwy. Engr., Bur. of Pub. Rds., Gainesville, Fla. 30

Fred W. Pease, City Engr., Porterville, Calif. 30

B. M. T. Ryder, Way Engr., 3rd Ave. R.R., New York, N. Y..... 30

Walter A. Shaw, Cons. Engr., Chicago, Ill.. 30

Geo. A. Tabor, Cons. Engr., Boston, Mass. 30

Geo. B. Wilson, Jr., Clinton Bridge Works, Clinton, Iowa 30

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Truck Industry Has Record Year

Approximately 100,000 More Units Turned Out in 1925 Than Ever Before—Total Production Estimated at 492,000

By Windsor T. White
Chairman, Motor Truck Committee, National Automobile Chamber of Commerce

With a total production estimated at 492,000 units, the motor truck industry had, in 1925, by far its most successful year. Not only was the previous production record of 392,760 exceeded by about 100,000 trucks, but the volume of business in dollars and cents also eclipsed the previous high wholesale value by about $65,000,000.

The great increase in truck production in 1923 was largely in the inexpensive one-ton and one and one-half-ton classes. The 1925 record, too, was made as a result of a further big increase in the number of light trucks manufactured, but also in the number of heavy duty trucks built.

The effect upon the whole industry of this greatly increased volume of business has been most salutary, taking up some of the slack which usually exists in an industry in which production capacity is in excess of the normal market requirements.

Part of the year's good record may be ascribed to the rapid development in the foreign market, although this was a negligible factor in the truck filed only three or four years ago.

15,000 Buses Manufactured in 1925

Another vital factor affecting particularly the great increase in wholesale value of the business done has been the rapid growth of the bus manufacturing industry. While the number of units manufactured last year is estimated at only about 15,000 as compared with about 10,000 in the previous year, the price of the bus unit is much larger than that of the heavy truck unit and frequently two or three times as large.

One factor which may have been prominent in bringing about the increase in the number of heavy duty trucks manufactured last year is the replacement of trucks put into service during the War and immediately after it. Many of these trucks have now been in service six or seven years and a great many of them were replaced last year.

During the past year remarkable strides have been taken by railroad leaders in attempting to work out plans for co-ordinating rail and highway service, as advocated in the past by the truck industry. A growing feeling among rail executives that their business is transportation, using whatever tools best fitted for carrying persons and freight economically and comfortably, has been displayed. At the beginning of the year only two railroads operated motor buses in passenger service, while at the present time some 20 steam railroads are operating directly or indirectly 367 buses. Also, there are now 51 steam railroads in the United States and Canada that are using motor trucks to supplement their shipping service as compared with 33 a year ago.

AAA Organizing Motor Transport

Before the motor truck reaches its ultimate field of usefulness, there must be a complete understanding of its economic field. It is essential that thoroughgoing studies be made by unbiased workers of the cost of commercial motor transportation. In this connection, progress has been made during the past year on an attempt to set up within the American Automobile Association a motor bus division and a motor truck division. These, with a passenger car division, should make possible ultimately one large organization of users of the highways, with each division carrying on important factual studies and giving special service to the members of its division. The conception of such relationship between the three groups is somewhat idealistic and it is therefore extremely gratifying to find that real progress has been made in this program.

Further Reinforcing-Bar Standardization to Be Considered

Two meetings of those interested in steel reinforcing bars were held in Washington on Jan. 26. The first was under the auspices of the Division of Simplified Practice of the Department of Commerce to consider possible revision of the 11 "recognized sizes" of bars adopted by general conference of producers and distributors Dec. 9, 1924. By unanimous vote the conference adopted a motion that these 11 sizes remain in effect until such time as changing conditions may make advisable the calling of another general conference of the same nature. Reports at the meeting showed that the adoption of the reduced number of sizes has become quite general.

A second meeting, with Secretary Hoover, under the auspices of the National Committee on Metal Utilization, brought together representatives of rolling mills, consumers, distributors, technical bodies, and other interested organizations, and adopted a resolution asking that a committee be appointed by the Department of Commerce to survey, through the proper channels of production, distribution and consumption, what grade or grades of new billet concrete reinforcing steel are most desirable. This committee is asked, under the terms of the motion, to conduct a referendum among users, distributors and producers, and to report at a general conference to be held soon after Oct. 1.

A. E. Lindau, chairman of the Committee on Grades of Reinforcing Steel and Standard Sizes of the Concrete Reinforcing Steel Institute, advocated a simplification of specifications. Other discussions were by F. E. Hughes, of the Franklin Steel Works, Franklin, Pa., president of the Rail Steel Products Association; E. F. Kenney, of the Bethlehem Steel Co.; C. E. Skinner, of the American Engineering Standards Committee; and Richard L. Humphrey, of the American Society for Testing Materials.

Business Notes

George L. Morehead, for the past 6 years attached to the management of the Link-Belt Company's Indianapolis plants has been made manager of the Philadelphia plant. Mr. Morehead graduated from the University of Missouri in 1902 and has been with the Link-Belt Co. for the past 19 years.

Mixermobile Corporation, Milwaukee, Wis., is the new name of the former Milwaukee Concrete Mixer Co.

The Cambria Clay Co. has discontinued its Philadelphia branch, which has been operating at 1600 Walnut St. in that city and the Cambria Clay Company of Philadelphia has been incorporated to handle the clay products of the Cambria Clay Co. The offices of the new company are at 929 City Center Building, Philadelphia, and the officers are L. A. Young, president; O. F. Schwegler, vice-president and manager; and J. Fred Blankenhorn, treasurer.

Westinghouse Electric & Mfg. Co., has received a contract from the Ryckoff Construction Co., Chicago, for 10,000 standard lighting units, reflectors and auxiliary equipment to be used in a new street lighting system for the city of St. Louis, Mo. A plant will be erected in St. Louis for the delivery of the hollowspun concrete poles at the rate of 1,000 each month as required by the contract.

John C. Bannister, vice president in charge of engineering, Walworth Mfg. Company, Boston, Mass., retired from active work effective January 1. F. H. Morehead, chief engineer of the company, will take over Mr. Bannister's responsibilities.

American Creosote Works, New Orleans, La., announces that it has completed plans for the purchase of the Atlantic Creosoting & Wood Preserving Works, Norfolk, Va. Plans are also being made to erect a new large and modern creosoting plant to take care of expanding eastern business. W. H.

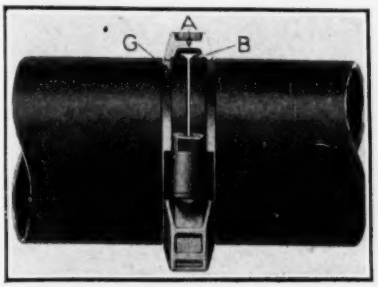
Wales, formerly president of the Atlantic Creosoting & Wood Preserving Works, will be in charge of the new plant. This plant will be operated under the management of the Savannah Creosoting Company which is connected with the American Creosote Works.

Equipment and Materials

Pipe Joints of New Design Flexible Under Pressure

A new design of pipe joint, known as the Victaulic joint, is being introduced by the Victaulic Co. of America, 26 Broadway, New York City. This company has the American, Canadian and Mexican rights for manufacturing and selling this joint, which has heretofore been used only in foreign countries.

The joint is designed to take the



place of ordinary flanged, screwed sockets, or bell-an-spigot joints and requires a special pipe having either grooved or beaded ends. The company states that several tube mills in the United States are now prepared to furnish such a pipe.

The joint consists of two half housings A, two bolts and nuts, and a leak-proof ring B. The half housings serve to locate the leak-proof ring over the ends of the pipe and also join the pipes together, allowing such clearances as are necessary to obtain flexibility and expansion. The leak-proof ring is stretched over the pipe end and the half housings bolted together over it, the whole operation being performed, it is claimed, in less than 2 min. on any size pipe up to 12 in. in diameter. The housings are made of malleable iron. It is claimed that this joint may be used for pressures up to as high as 1,000 lb. and still retain its flexible and leaktight qualities.

This joint has been in use for five years on pipe lines carrying compressed air, water, oil, gas, brine, ammonia, and sewage.

Some of the advantages claimed for this type of joint are saving in cost of installation, elimination of expansion joints, ease of removal without disturbing abutting pipe since a section can be removed by a straight horizontal movement. Also, it is claimed that these pipes cannot be wrongly fitted and that interchangeability with other types of piping is an advantage. Because of their flexibility, pipe lines using this type of joint are said to have proved very successful over rough and uneven ground on lines subject to vibration and lines that frequently have to be moved. The joint may be re-laid by using the same parts repeatedly.

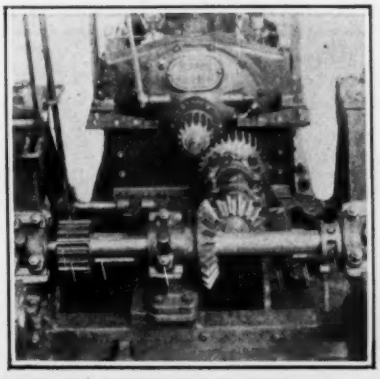
Floodlight Projectors Do Not Require Ventilation

A new line of floodlighting projectors in three sizes, the largest of which will accommodate 750 to 1,000 watts standard gas filled lamps has been designed by the Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa. It is claimed that no ventilation is necessary and that all heat generated by the lamps is dissipated by radiation. The units are dust-proof and constructed to withstand hard usage. They are mounted on cast iron bases by means of a steel trunnion or bow. They are finished in hard black glossy finish which is claimed to be oil, water and acid-proof.

The lamps used with these projectors may be focused by adjusting the set screws which are placed in accessible positions on top of the projector. The reflectors are of metal, spun over metal forms assuring a high degree of accuracy and beam control. The reflecting surface is highly polished and designed to give maximum efficiency during the life of the projector. The projector body is made of cast iron. A cast-iron door frame, gasketed to exclude moisture and dust from the interior of the unit, supports the glass front. In the larger size projectors the door is hinged and is equipped with swivel bolts and handles for tightening. A convex heat-resisting glass front is used which it is claimed will not crack when the projector is operating during rain or snowstorms.

Drive on Gasoline Hoist Changed from Chain to Gears

The gasoline hoist manufactured by the American Hoist & Derrick Co., St. Paul, Minn., has recently been redesigned, changing it from a chain drive to a gear drive. The new hoists are driven by means of spur and bevel gears with an intermediate longitudinal shaft placed at right angles with the pinion shaft. This pinion shaft is the crankshaft on a steam hoist, the gasoline motor being mounted lengthwise instead of crosswise on this new hoist design. This gear arrangement is plainly shown in the accompanying illustration, in which the gear guard and drums have been removed.



Equipping gasoline hoists with gear drive instead of chain drive is claimed to give a number of important advantages. Among these advantages are speedier shipment of both hoist and driving mechanism repairs, ability to change the line speed to meet varying requirements without seriously delaying shipment, and finally, and most important, that the power is transmitted directly to the pinion shaft of the hoist which is between the two rear drums, and from there to the friction drums by at least two teeth—one to each adjoining friction gear. Under the old arrangement power was transmitted to the rear drum and from there to the rest of the drums by only one gear tooth.

The entire hoist is mounted on a cast iron bed plate, which it is claimed insures rigidity and absolute alignment of gearing, shafting, and bearings. Provision is made for bolting on an additional drum in front of the hoist, should it be necessary only to buy one drum initially.

Publications from the Construction Industry

Hoists—NOVO ENGINE CO., Lansing, Mich., has issued a handbook or manual containing valuable information about hoists and hoisting work. It is entirely devoted to applications of hoists in various kinds of duties, including platform elevators and material concrete handling equipment, clamshells and derricks, steel erection, industrial car hauling, drop hammer pile driving, dragline work and the logging industry. Tables and data are given showing methods of figuring drum capacities, cable sizes etc.

Compressors—THE BUHL CO., Chicago, has issued bulletin 90C describing its portable compressors and combination compressor-hoists.

Welding and Cutting Equipment—SMITH INVENTIONS, INC., Minneapolis, Minn., has issued a 50-p. catalog describing its line of welding and cutting equipment. The equipment described in the catalog includes both complete welding and cutting outfits as well as torches, regulator parts, and other accessories.

Excavators — BAY CITY DREDGE WORKS, Bay City, Mich., has recently issued catalogs 24 and 25 describing its one man convertible excavator and its 16-B convertible excavator, respectively. These machines operate skimmer scoop, trench scoop, shovel, clamshell or dragline and the catalog illustrates the use of the machine with these different attachments on a wide range of work.

Engineering News-Record Statistics of the Construction Industry

Feb. 4, 1926 — *in the United States* — Vol. 96, No. 5

Engineering News-Record CONSTRUCTION COST Index Number (1913 = 100)

MONTHLY

January, 1924 to Date

February, 1926	**206.55**
January, 1926	207.15
February, 1925	209.70
Peak, June, 1920	273.80
1913	100.00

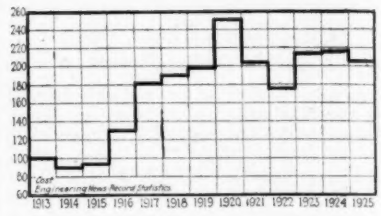
1924					
Jan.	217.90	May	222.38	Sept.	211.25
Feb.	220.30	June	216.85	Oct.	207.55
March	224.60	July	214.40	Nov.	205.70
April	221.60	August	213.15	Dec.	208.58

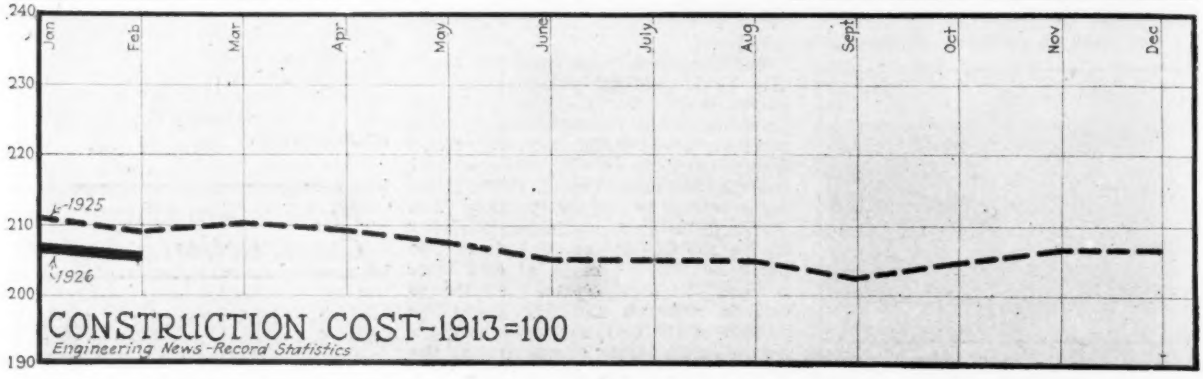
1925					
Jan.	210.40	May	207.20	Sept.	202.10
Feb.	209.70	June	204.60	Oct.	205.35
March	210.20	July	204.60	Nov.	205.95
April	209.55	August	204.60	Dec.	205.95

ENGINEERING NEWS-RECORD'S Construction Cost Index Number is 0.2 per cent below January, 1926, owing to lower cost of lumber due indirectly to blocked Florida shipments. The average rate for common laborers is still 54c. per hr. for the entire country as against 53c. five months ago and 54c. one year ago. Thus general construction cost is 1.5 per cent below a year ago and 25 per cent under the peak; it is 106 per cent above the 1913 level.

YEARLY

1913 to 1925





Engineering News-Record CONSTRUCTION VOLUME Index Number (1913 = 100)

MONTHLY

January, 1924, to January, 1926

January, 1926	**198**
December, 1925	206
January, 1925	141
Peak, August, 1925	266
1913	100

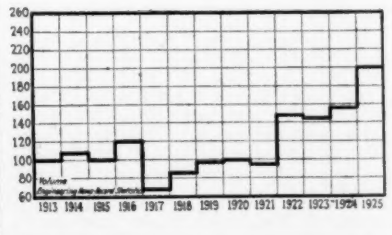
1924					
January	125	May	194	September	159
February	144	June	149	October	164
March	161	July	161	November	128
April	159	August	162	December	145

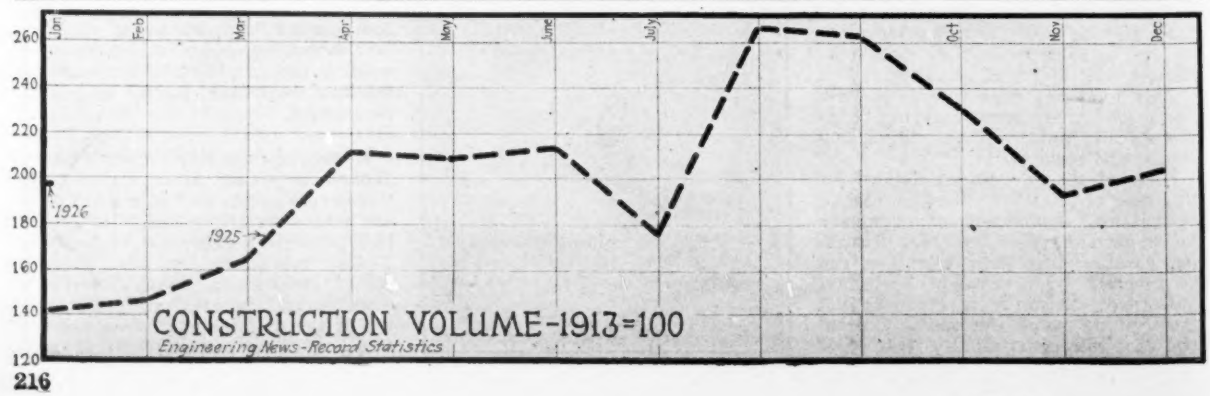
1925					
January	141	May	209	September	262
February	145	June	214	October	233
March	161	July	178	November	194
April	211	August	266	December	206

ENGINEERING NEWS-RECORD'S Construction Volume Index Number is 198 for the month of January, and 201 for the whole of 1925, as against 100 for 1913. This means that the actual volume of construction in 1925 (not the mere money-value of the contracts let that year) is 101 per cent above the volume of construction for 1913. The monthly volume number, 198 for January, 1926 contains the increment of construction and indicates the rate at which contracts are being let as compared with 1913 awards.

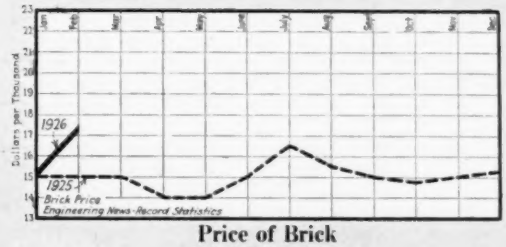
YEARLY

1913 to 1925

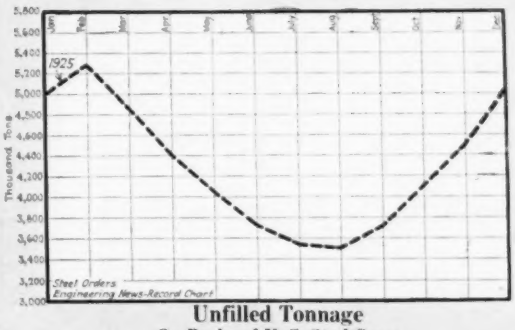




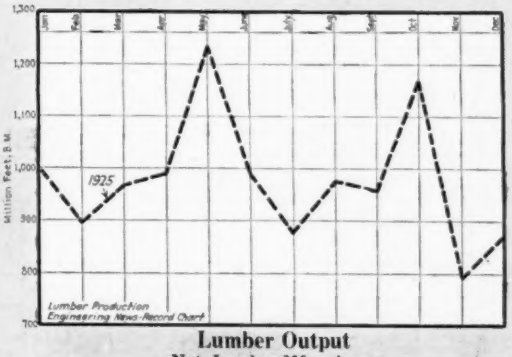
Monthly Statistics of the Construction Industry



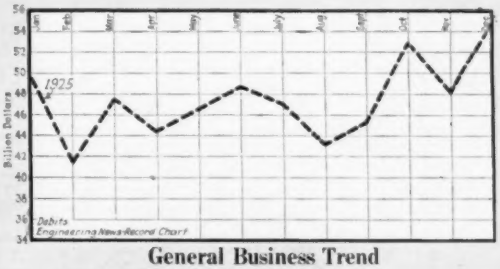
Price of Brick
At Dock, New York



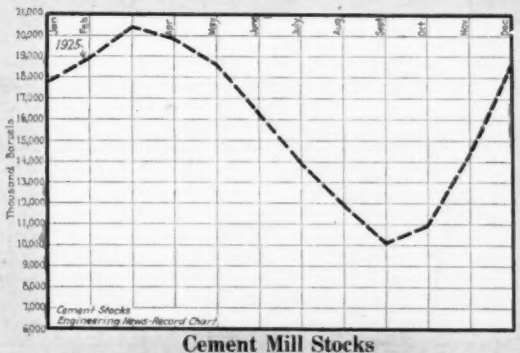
Unfilled Tonnage
On Books of U. S. Steel Corp.



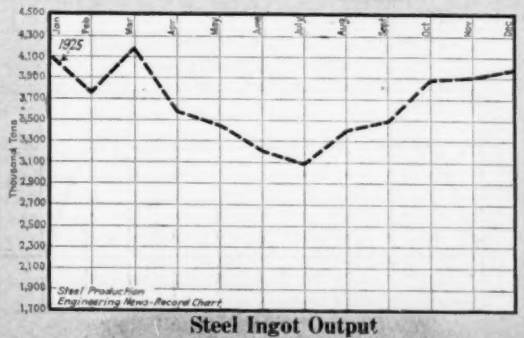
Lumber Output
Nat. Lumber Mfrs. Assn.



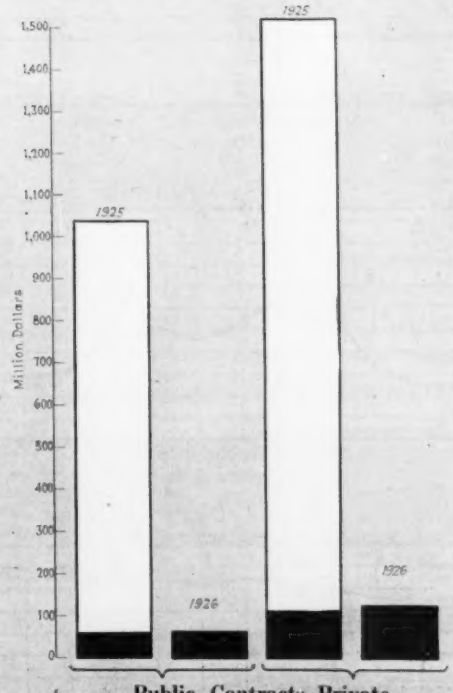
General Business Trend
Bank Debits—Federal Reserve



Cement Mill Stocks
Geological Survey

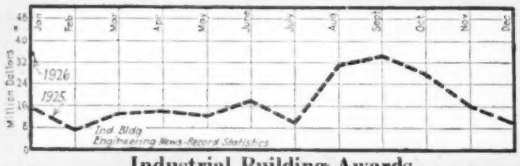


Steel Ingot Output
Gross Tons; Am. Iron and Steel Inst.

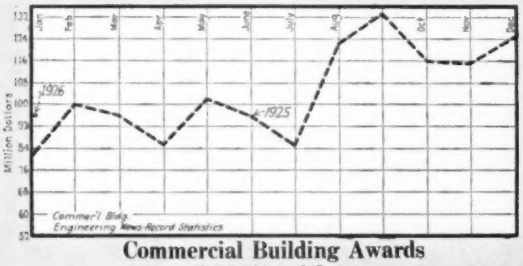


Public—Contracts—Private
Jan. 1 to date
Reported by E. N.-R.

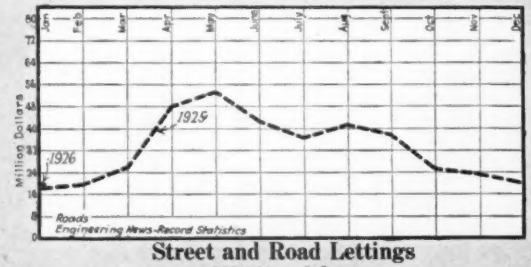
Contracts Awarded in the United States
Reported in E. N.-R.



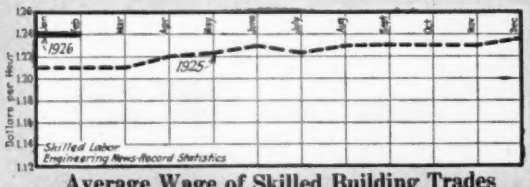
Industrial Building Awards
$40,000 and Over



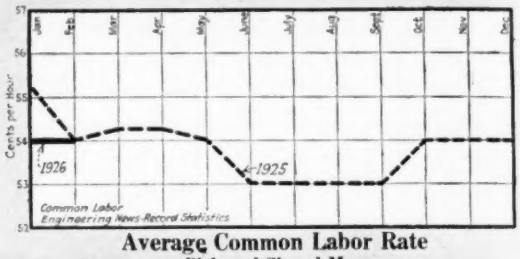
Commercial Building Awards
$150,000 and Over



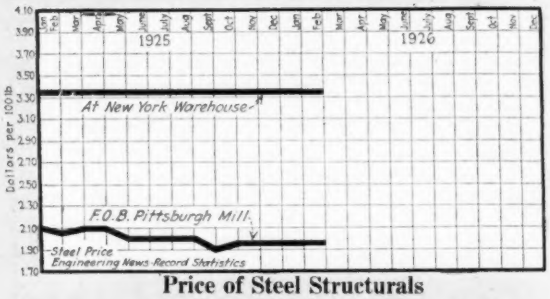
Street and Road Lettings
$25,000 and Over



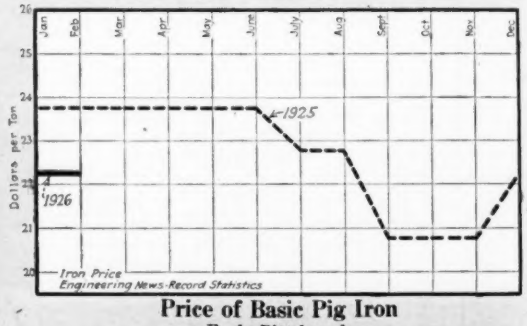
Average Wage of Skilled Building Trades
Bricklayers, Carpenters and Steel Erectors



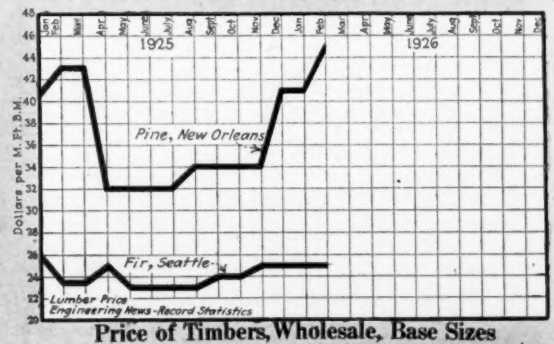
Average Common Labor Rate
Pick and Shovel Men



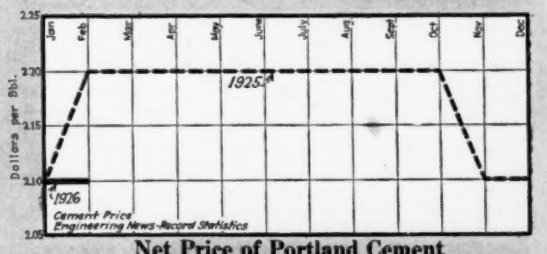
Price of Steel Structurals
Shapes 3-In.; Plates ¼-In.



Price of Basic Pig Iron
F.o.b. Pittsburgh



Price of Timbers, Wholesale, Base Sizes
Car Lots to Contractors



Net Price of Portland Cement
Car Lots, F.o.b. Chicago

January Contracts Reach Record Total For That Month— Upward Trend Most Marked in the West

THE month just closed established a record for mid-winter construction not reached in any corresponding period during the past fourteen years. The gain was in actual volume as well as in money value of contracts awarded. The accompanying tabulations show total awards for the nation during December, 1925, January, 1926, and the entire year 1925 at the following minimum cost in each class: water-works and excavations, $15,000; other public works, $25,000; industrial buildings, $40,000; and commercial buildings, $150,000.

While January contracts showed a seasonal decline from the total of the month preceding, there was substantial increase in lettings for water-works, sewers, private excavating projects, streets and roads, and industrial buildings.

The seasonal slow-down was particularly marked in Delaware, Virginia, West Virginia, Minnesota, Arkansas, Montana, Colorado, Utah, and Nevada. Notable activity, however, was shown in eighteen of the states, namely: New Hampshire, Connecticut, Maryland, Georgia, Florida, Alabama, Kentucky, Tennesee, Ohio, Michigan, Iowa, South Dakota, Kansas, Texas, Wyoming, New Mexico, Idaho and Oregon.

Judging from projects in the proposed stage as late as Jan. 31, 1926 (88 per cent of which will have been awarded by Apr. 30) there is a definite upward trend in construction of sewers in the Midwestern and Pacific Coast states; bridges, in the Far West; streets and roads, in the South; the last mentioned class together with industrial buildings, in the Middle Atlantic section and the West; and commercial buildings in New England.

Value of Contracts Let in the United States and Canada, January, 1926

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States	Canada
Water-works	.....	$211,000	$475,000	$1,265,000	$1,432,000	$34,000	$3,347,000	.....
Sewers	.....	474,000	392,000	3,758,000	257,000	3,607,000	8,488,000	$298,000
Bridges	.....	368,000	1,779,000	649,000	1,235,000	1,438,000	5,469,000	500,000
Excavation, drainage, etc	.....	10,000	1,107,000	100,000	451,000	92,000	1,760,000	.....
Streets and Roads	$324,000	5,044,000	3,015,000	3,560,000	5,477,000	2,569,000	19,989,000	144,000
Industrial Building	595,000	21,544,000	4,432,000	5,672,000	1,195,000	1,881,000	35,319,000	1,590,00
Commercial Building	6,532,000	34,260,000	11,886,000	25,434,000	9,186,000	9,262,000	96,560,000	4,234,00
Federal Government	21,000	1,053,000	999,000	6,000	180,000	187,000	2,446,000	.....
Unclassified	500,000	8,121,000	840,000	457,000	6,408,000	943,000	17,269,000	613,000
January, 1926	$7,972,000	$71,085,000	$24,855,000	$40,901,000	$25,821,000	$20,013,000	$190,647,000	$7,384,000
December, 1925	11,699,000	101,006,000	23,811,000	51,932,000	25,602,000	43,869,000	246,919,000	1,232,000
January, 1925	12,948,000	51,863,000	15,801,000	25,922,000	33,398,000	31,167,000	171,099,000	4,861,000

Value of Contracts Let in the United States and Canada, December, 1925

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Far West	United States	Canada
Water-works	$25,000	$491,000	$188,000	$798,000	$459,000	$706,000	$2,667,000	$55,000
Sewers	156,000	372,000	236,000	11,066,000	1,496,000	716,000	4,042,000	280,000
Bridges	.....	4,722,000	2,471,000	976,000	874,000	432,000	9,475,000	.....
Excavation, dredging, etc	25,000	59,000	78,000	1,080,000	1,837,000	1,043,000	4,122,000	.....
Streets and roads	447,000	2,827,000	7,130,000	2,233,000	2,915,000	4,083,000	19,635,000	344,000
Industrial buildings	1,455,000	1,187,000	2,355,000	3,985,000	2,517,000	140,000	11,639,000	.....
Commercial buildings	9,384,000	73,759,000	8,792,000	40,261,000	7,839,000	15,815,000	155,850,000	150,000
Federal Government	17,000	1,217,000	21,000	78,000	629,000	810,000	2,772,000	.....
Unclassified	190,000	16,372,000	2,540,000	1,455,000	7,036,000	9,124,000	36,717,000	403,000
December, 1925	$11,699,000	$101,006,000	$23,811,000	$51,932,000	$25,602,000	$43,869,000	$246,919,000	$1,232,000
November, 1925	11,518,000	64,228,000	21,039,000	38,378,000	25,804,000	24,663,000	185,600,000	5,985,000
December, 1924	15,661,000	38,267,000	6,300,000	37,681,000	22,649,000	20,458,000	141,016,000	13,747,000

Value of Contracts Let in the United States and Canada During the Entire Year 1925

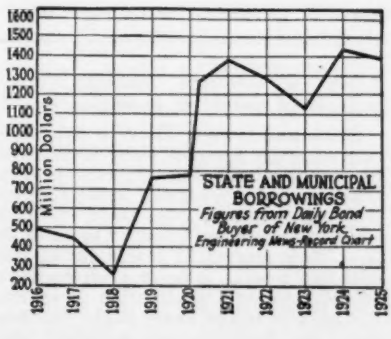
	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Far West	United States 1925	Canada	United States 1924
Water-works	$2,203,000	$11,845,000	$3,305,000	$14,710,000	$20,018,000	$17,287,000	$69,368,000	$3,115,000	$61,445,000
Sewers	2,014,000	30,074,000	2,389,000	24,417,000	16,426,000	9,257,000	84,577,000	5,008,000	74,553,000
Bridges	1,555,000	18,802,000	15,138,000	10,207,000	13,079,000	11,095,000	69,876,000	2,408,000	68,564,000
Excavation, dredging, etc	124,000	843,000	19,410,000	4,923,000	4,803,000	9,977,000	40,080,000	10,872,000	27,010,000
Streets and roads	15,519,000	95,297,000	74,355,000	92,069,000	94,235,000	49,564,000	421,039,000	13,874,000	415,216,000
Industrial buildings	26,918,000	47,369,000	27,929,000	50,669,000	52,268,000	22,463,000	227,616,000	16,006,000	204,969,000
Commercial buildings	146,186,000	588,834,000	81,573,000	257,013,000	156,842,000	143,652,000	1,374,100,000	13,002,000	935,430,000
Federal Government	1,374,000	7,878,000	8,786,000	4,634,000	4,596,000	7,004,000	34,272,000	.....	38,885,000
Unclassified	3,477,000	134,274,000	15,081,000	15,570,000	45,291,000	24,822,000	238,515,000	18,782,000	173,218,000
Total, 1925	$199,370,000	$935,216,000	$247,966,000	$474,212,000	$407,558,000	$295,121,000	$2,559,443,000	$83,067,000	.....
Total, 1924	$151,556,000	$601,152,000	$208,072,000	$431,039,000	$340,622,000	$266,849,000	.....	$102,923,000	$1,999,290,000

Labor Rates and Conditions Throughout the Country

EASY credit, the natural resultant of surplus money, obviously controls the present building situation and to all appearances there will be no change in trend during the first half of the current year.

Record achievements during 1925 in construction volume, steel and cement production, and revenue freight loadings (all inter-related) were made possible by this plentitude of loanable funds. Building materials and automotive products together formed a very large percentage of total freight loadings for the year.

Speculative building, stock market inflation, and automotive sales will therefore continue at the present rate until there is further tightening in credit extensions.



State and municipal borrowings, mostly for improvements involving engineering operations, have been on the up-trend since the close of the world war. The drop in the 1925 total, compared with the year preceding, may mark the beginning of a gradual downward movement in this class of construction.

Trade and industry may soon expand to fill the empty floor space created by the boom but from present indications, speculators are proceeding with little regard for building shortages, actual

Current Building Trades Wage Rates Per Hour

(Higher rates indicated by +, decreases by —)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	$0.70	$0.70	$0.50	.....	$0.75	$0.25@.30
Baltimore	1.50@1.75	1.00@1.10	1.00@1.12½	1.00	$0.65	1.12½	.40
Birmingham	1.00@1.50	.35@.87½	.75@1.25	.50@.75	.....	.75@1.75	.20@.40
Boston	1.25	1.10	1.10@1.30	.75	1.10	1.10@1.25	+.50@.75
Cincinnati	1.50	1.25	1.25	.92½	1.25	1.25	40@55
Chicago	1.50	1.37½	1.37½	.87½	1.37½	1.37½	.82½@.87½
Cleveland	1.50	1.25	1.30	.87½	1.00	1.50	.87½
Dallas	1.62½	1.12½	1.00	.40@.75	.87½	1.00	.30@.50
Denver	1.62½	1.12½	1.12½@1.18¾	.81¼@.87½	1.00	1.15⅝	.35@.55
Detroit	1.50	70@1.00	.85@1.00	.90	.85@1.00	1.12½	.50@.60
Kansas City	1.37½	1.12½	1.12½@1.25	.90	1.12½	1.25	—.35@.75
Los Angeles	1.25	1.00	1.00	.87½	.75	1.00	.50
Minneapolis	1.12½@1.25	.87½@90	.87½	.71½	.....	.87½	.45@.55
Montreal	.90	.65	.56¾	25.@.30	.50	.80	.20@.30
New Orleans	1.25	.90	1.00	.65	.85	1.25	.35@.40
New York	1.50	1.31¼	1.50	1.00	1.00@1.12½	1.50	.62½@.75
Philadelphia	+1.62½	1.12½	1.02¼	1.12½	....	1.12½@1.25	.45@.50
Pittsburgh	1.62½	1.37½	1.37½@1.43¾	1.09⅜	....	1.43¾	.75
St. Louis	1.75	1.50	1.50@1.65	1.15@1.25	1.50	1.50	.45@1.00
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.55
Seattle	1.37½	1.12½	1.00@1.12½	1.00	1.00@1.12½	1.12½	.50@.62½

demand, receding rents, or other factors except the ease with which credit can be obtained.

The labor situation is favorable to a continuation of the present trend in building, since wage or other disputes are pending in only five of twenty most important industrial centers of the country.

Monthly Prices of Construction Materials

Ups and Downs of the Market

THE price movement in most of the basic materials is at present in a downward direction, with possibilities of slight reaction in the spring. Principal declines of the month were in railway supplies, paving materials, steel, scrap, explosives, and paint stuffs. Advances occurred in brick, sewer pipe (8-in. and under) and certain items on the lumber list. The pig-iron market is unbroken and cement and steel pipe hold firm. The aggregates will probably remain at present levels until April 1. Anthracite shortage and obstruction of navigation by ice threaten New York City with another period of brick scarcity.

Pig Iron—Considerable improvement over a week ago is noted in the pig-iron market; prices remain unchanged from the Jan. 1 level and show an excess of declines compared with a year ago.

Railway Supplies—Railroad buying continues active and standard rails retain their usual firmness. Track bolts and other supplies are higher. Slight weakness, however, is evident in light and re-rolled rails, oak and cypress ties.

Pipe—The characteristic price firmness of steel pipe is still evident. Clay pipe also remains firm with an upward tendency in sewer pipe at factory. Aside from slight declines during the month in cast-iron pipe at Pittsburgh and St. Louis, the general trend is upward.

Road and Paving Materials—St. Louis appears to be the only one of twenty-one cities reporting regularly to *Engineering News-Record*, in which there is any show of firmness in paving materials. Asphalt is down from the Jan. 1 levels in Detroit and Philadelphia; Kansas City, Mo., reports declines in asphalt, paving stones, and wood blocks. The other seventeen cities show no changes.

Sand, Gravel and Crushed Stone—Prices of aggregates, generally, will show little change before April 1. Fluctuations during January consisted of a decline in gravel prices at Kansas City; a rise in sand at Los Angeles; and advances in crushed stone at Los Angeles and Atlanta.

Lime and Cement—Western lime is higher while prices in parts of the South tend downward. Stability characterizes the market in cement.

Brick and Hollow Tile—In the presence of active demand, those sections of the country suffering from anthracite shortage and stoppage of navigation by freezing weather, are faced with a scarcity of common brick. The price at New York jumped $2 per M during the past two weeks; in most other sections of the country the situation is easier. Hollow tile prices show slight fluctuation; the trend is not definitely upward.

Structural Steel—While the general tendency in steel is toward slightly lower prices, there is firmness in shapes, bolts, nuts and sheets. Steel plates range from $1.80 to $1.90 per 100 lb., Pittsburgh, with $1.60 mentioned, this is about 10c. per 100 lb. below the Jan. 1 level. Reinforcing bars are $2, the $2.10 maximum of a month ago having disappeared. Shapes remain at the old level of $1.90@$2 per 100 lb., at mill, in carload lots or over.

Lumber—The market shows indications of recovery from the holiday lull with price advances slightly in excess of declines. All of the price rises occurred in pine while most of the recessions were in Douglas fir. Hemlock and spruce boards and timbers showed little tendency to fluctuate.

Scrap—Prices are below the Jan. 1 level in New York and Chicago; Birmingham market remains unchanged.

Explosives—Special 40 and 60 per cent gelatin dynamite are 0.5c. to 1½c. per lb. lower in New York, Chicago, Birmingham and several other centers, compared with a month ago.

Paint Materials—Linseed oil is down 5½c. per gal. in New York from the Jan. 1 level. Minneapolis market reports similar reaction. Red and white lead are 1c. per lb. below a year ago.

Miscellaneous—Prices are firm and unchanged in rivets, nails, spikes, and piling other than steelsheet. Rope is tending upward. With the exception of copper sulphate, water and sewage treatment chemicals are cheaper than a month ago.

E. N.-R. Prices of Construction Materials

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton f.o.b.:

CINCINNATI	Feb. 4	One Year Ago
No. 2 Southern (silicon 2.25@2.75)	$24.05	$24.05
Northern Basic	24.27	23.77
Southern Ohio No. 2 (silicon 1.75@2.25)	24.27	23.77
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25@2.75)	28.37	30.25
BIRMINGHAM		
No. 2 Foundry (silicon 2.25@2.75)	22.00@23.00	20.00@20.50
PHILADELPHIA		
Eastern Pa., No. 2X (2.25@2.75 sil.)	24.16	24.76
Virginia No. 2 (silicon 2.25@2.75)	29.17	30.17
Basic	23.16	24.76
CHICAGO		
No. 2 Foundry Local (silicon 1.75@2.25)	23.00	22.00
No. 2 Foundry Southern (silicon 2.25@2.75)	26.55	25.55
PITTSBURGH, including freight charge ($1.76) from the Valley		
No. 2 Foundry Valley (silicon 1.75@2.25)	22.27	23.77
Basic	22.27	23.77
Bessemer	22.27	23.77

SCRAP—The prices following are f.o.b. per ton paid by dealers:

	New York	Chicago	Birmingham
No. 1 railroad wrought	$14.75	*$13.50@$14.00*	$13.00@$13.50
Stove plate	*11.00*	15.00@ *15.25*	14.00@ 14.50
No. 1 machinery cast		*17.00@ 17.50*	17.00@ 17.50
Machine shop turnings	*10.25*	*8.00@ 8.50*	8.00@ 8.50
Cast borings	12.25	**12.00@** 12.25	8.00@ 8.50
Railroad malleable	17.00	*15.00@ 15.50*	17.00@ 18.00
Re-rolling rails	*13.75*		16.50@ 17.00
Re-laying rails	23.50		21.00@ 22.00
Heavy melting steel	*12.25*	*13.00@ 13.50*	

Railway Supplies

STEEL RAILS—The following quotations are per ton f.o.b. for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh				
	Feb. 4	One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$43.00	$43.00	$43.00	
Standard openhearth rails	43.00	43.00	43.00	43.00	**$51.00**
Light rails, 8 to 10 lb.		36.00	34@36	1.80@1.90	*2.05**
Light rails, 12 to 14 lb.		36.00	34@36	1.80@1.90	*1.88**
Light rails, 25 to 45 lb.	36@38	36.00	34@36	1.80@1.90	*1.84**
Re-rolled rails	*30@34*	27@32			17.50@18.00

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, white oak, plain	$1.35	$1.65
Chicago, empty cell creosoted	1.70	2.00
Chicago, zinc treated	1.50	1.80
San Francisco, green Douglas fir	.84	1.14
San Francisco, empty cell creosoted, Douglas fir	1.70	2.25
St. Louis, white oak, plain	*1.15*	1.45
St. Louis, zinc treated	*1.55*	1.85
St. Louis, red oak, plain	*1.05*	1.35
St. Louis, sap pine-cypress	*.90*	1.20
Birmingham, white oak	1.25	1.45

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh mill for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					
	Feb. 4	One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$2.80	$2.90	$3.55	$3.65	$4.35	$3.00
Track bolts	3.90@4.25	3.90@4.25	4.55	**4.40**	*5.35*	3.90
Standard section angle bars	2.75	2.75@2.85	3.40	3.25@3.75	4.00	**4.15**

Pipe

WROUGHT PIPE—The following discounts are to jobbers for carload lots at Pittsburgh mill:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	1 to 1½	30	13
LAP WELD					
2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

STEEL PIPE—From warehouses at the places named the following discounts hold for welded steel pipe:

	Black			
	New York	Chicago	Birmingham	St. Louis
1 to 3 in. butt welded	53%	54%	62%	49%
2½ to 6 in. lap welded	48%	51%	59%	46%
	Galvanized			
	New York	Chicago	Birmingham	St. Louis
1 to 3 in. butt welded	39%	41%	50½%	36%
2½ to 6 in. lap welded	35%	38%	43½%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36—5% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

			New York	
	Birmingham	Burlington, N. J.	Feb. 4	One Year Ago
4 in.	$45.00	$52.00@$54.00	$54.60@56.60	$59.60@60.60
6 in. and over	41.00@42.00	48.00@ 50.00	50.60@52.60	54.60@55.60
	Pittsburgh	Chicago	St. Louis	San Francisco
4 in.	*$52.20@54.20*	$53.20@54.20	*$51.60*	$55.00
6 in. and over	*48.20@50.20*	50.20@51.20	*47.60*	51.00

Gas pipe and Class "A," $4 per ton extra.

CLAY DRAIN TILE—The following prices are per 1,000 lin.ft.:

	New York					
Size, In.	Feb. 4	One Year Ago	St. Louis	Birmingham	San Francisco	Dallas
3	$48.00	$48.00	$40.00	$45.00		$73.00
4	60.00	50.00	40.00	56.00	$76.50	110.00
5				80.00	97.75	118.00
6	90.00	92.00	70.00	100.00	127.50	150.00
8	160.00	160.00	170.00	165.00	212.50	210.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3		**$0.108**	$0.10		$0.09	$0.12	
4		**.108**	.10	$0.10	.09	.15	$0.15
5		**.1485**	.135		.13½	.18	.18
6	$0.21	**.1485**	.135	.14	.13½	.21	.21
8	.35	**.243**	.21	.225	.21	.30	.325
10	.52	.2835	.315	.315	.31½	.42	.476
12	.66	.3645	.45	.405†	.40½	.56	.612
15	1.14†	.486	.54	.675†	.54	.92	1.02
18	1.65†	.675	.75	.945†	.75	1.32	1.53
20	1.98†	.81	.90	1.26†	.90		
22	2.65†	1.08	1.20		1.20		1.564
24	2.97†	1.215	1.35	1.62†	1.35	2.16	2.04
27	4.65†	2.405	2.665	2.45†	2.75	3.00	3.34
30	5.16†	2.664	2.952	3.00†	3.75	3.60	4.06
33	6.98†	3.60	3.96	3.55†	4.50		4.99
36	8.00†	4.10	4.51	3.95†	5.00		5.42

	3	5	8	12	24	36
Boston	$0.13	$0.20	$0.30	$0.60	$2.00†	$5.50†
Minneapolis			.225	.405	1.35	4.75
Denver	.135*	.18*	.27	.47	1.70	
Seattle	.14		.35	.72†	2.60†	
Los Angeles	.1625	.195	.275	.495	1.65	
New Orleans	.115*	.117*	.295	.4725	1.575	
Cincinnati	.105	.1575	.245	.4725	1.575	4.715
Atlanta	.10*	.15*	.25	.425	1.625	
Montreal	.68‡	.45†	.70	1.35	4.50†	
Detroit	.11	.1665	.259	.4995	2.25†	7.175†
Baltimore	.111	.166	.259	.499	1.665	4.92
Kansas City, Mo.	.15*	.21*	.29	.52	1.90†	3.80†
Philadelphia	.11	.17	.26	.50	1.67	3.80

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

Road and Paving Materials

ROAD OILS—Following are prices per gallon in tank cars, 8,000 gal. minimum f.o.b. place named:

		Feb. 4	One Year Ago
New York, 45% asphalt	(at terminal)	$0.065 @$0.07	$0.07
New York, 65% asphalt	(at terminal)	.0675@ .0725	.0725
New York, binder	(at terminal)	.07 @ .075	.075
New York, flux	(at terminal)	.07 @ .075	.075
New York, liquid asphalt	(at terminal)	.07 @ .075	.075
St. Louis, 40@50% asphalt		**.057**	.0592
St. Louis, 50@60% asphalt		**.0575**	.0597
Birmingham, 55% asphalt		.0475	.0475
Dallas, 45% asphalt		.0495	.0495
Dallas, 55% asphalt		.0455	.0455
Dallas, binder		.061	.061
San Francisco, binder, per ton		12.00*	12.00*

* F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

E. N.-R. Prices of Construction Materials

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Texas*)	$23.00	$18.50
Boston (*Mexican*)	22.50	18.50
Chicago (*Texas*)	27.00	23.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	18.00	12.00
Dallas (*Texas*)	27.10	21.10
Seattle, "*D*" *grade, California, f.o.b. Richmond*	19.50	13.50
Denver (*California*)	24.00	.....
Minneapolis, *f.o.b. Twin Cities* (*Stanolind*)	27.60	21.60
St. Louis (*Mexican*)	25.00	**22.00**
Baltimore (*Mexican*) (*f.o.b. refinery*)	22.50	18.50
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	24.60	20.40
Detroit (*Mexican*)	*26.90*	*22.90*
Cincinnati (*Kentucky Rock*)	.....	11.65
Maurer, N. J. (*Bermudez*)	30.00	.....
Maurer, N. J. (*Trinidad*)	23.00	.....
Philadelphia (*Mexican*)	*20.00*	*18.00*
Kansas City, Mo. (*Texas*)	*24.00*	*19.00*
Los Angeles ("*D*" *grade, California*)	*18.00	*12.00
Birmingham (*Mexican*)	27.00	21.00
New Orleans (*Mexican*)	26.00	17.00

*F.o.b. El Segundo Refinery. Drums used in New York.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade I)	5-in. granite, 30 blocks per sq.yd	$147.00 per M.
San Francisco	Basalt block 4x7x8	70.00 per M.
Chicago	about 5x8x5 dressed	3.60 per sq.yd
	about 5x8x5 common	3.25 per sq.yd.
Boston	5-in. Granite	135.00 per M.
Atlanta	Granite	2.50 per sq.yd.
Detroit	5-in. Granite	3.00 per sq.yd.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4x8x4	3.18 per sq.yd.
Cincinnati	Granite	135.00 per M.
St. Louis	Granite, 4x8x4	1.65 per sq.yd.
Kansas City	Granite	*3.25* per sq.yd.
Philadelphia	Granite	3.90@4.25 per sq.yd.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft. wide	$0.24 per sq.ft.
	Manhattan, 4 ft. wide	.24 per sq.ft.
	Queens, 5 ft. wide	.26 per sq.ft.
	6x24-in. cross-walk	1.30 per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5x16 in., 88c.; *St. Louis*: Class "A" straight, delivered, 5x18 in., $1.05 per lin.ft.; roundings, $1.60. *Birmingham*: Limestone, 5x18-in., $1.05 per lin.ft.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York	3	16	$2.40
New York	3½	16	2.70
Boston	3½	18	2.50
Chicago	4	16	2.25
Chicago	3½	16	2.10
St. Louis	3½	16	**2.45**
St. Louis	4	16	**2.75**
Seattle	4	16	Off market
Minneapolis	3½	16	2.49
Atlanta	3½	16	2.00
New Orleans	3	16	2.20
New Orleans	3½	16	2.30
New Orleans	4	16	2.40
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4.50
Detroit	3	16	1.94
Detroit	4	16	.....
Cincinnati	3½	16	2.35
Kansas City	4	16	*2.50*
Philadelphia	4	16	None used

Construction Materials

SAND AND GRAVEL—Price for cargo or carload lots to contractor f.o.b., per cu.yd. is as follows:

	Gravel 1½ In.		Gravel ¾ In.		Sand	
	Feb. 4	One Year Ago	Feb. 4	One Year Ago	Feb. 4	One Year Ago
New York (*alongside dock*)	$1.75	$1.75	$1.75	$1.75	$1.00	$1.25
Denver	1.90	1.90	1.90	1.90	1.00	1.00
Chicago	1.65	.....	1.65	.....	1.50	.....
St. Louis	1.45	1.45†	1.45	1.45†	1.08	1.18†
Seattle	1.50	1.50	1.50	1.50	1.50	1.50
Dallas	2.38	2.38	2.38	2.38	2.00	2.00
Minneapolis	1.65*	1.65*	1.65*	1.65*	1.25	1.25
Cincinnati	1.40†	1.40†	1.40†	1.40*	1.35†	1.35†
San Francisco	2.15	2.15	2.15	2.15	1.50	1.50
Boston	1.50†	1.50†	1.50†	1.50†	1.00†	1.00†
New Orleans	2.60	2.63	2.60	2.63	1.75	1.75
Los Angeles	1.15†	1.50†	1.15†	1.55†	.90*†	1.10†
Atlanta	1.90†	1.90†	1.90†	1.90†	1.50†	1.40†
Detroit	2.02	2.02	2.02	2.02	1.62	1.62
Baltimore	1.40	1.40	1.60	1.60	.70*†	.70*†
Montreal	1.25†	1.25†	1.25†	1.25†	1.25†	1.25†
Birmingham	2.00	2.00	2.00	2.00	1.50	1.45†
Philadelphia	2.10	2.10	2.10	2.10	1.50	1.50
Kansas City	*3.20*‡	4.00‡	*3.20*‡	4.00‡	.66*†	.66*†

New York—Grits, $1.75 per cu.yd.; ready mixed $1.85.
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit. † Per ton. ‡ Joplin chats.

CRUSHED STONE—Price for cargo or carload lots, per cu.yd. f.o.b. city, is as follows:

	1½ In.		¾ In.	
	Feb. 4	One Year Ago	Feb. 4	One Year Ago
New York	$1.75	$1.75	$1.85	$1.85
Chicago	1.75	.....	1.87½	.....
St. Louis	1.93*	1.75*	1.93*	1.75*
Dallas	2.40	2.40	2.83	2.83
San Francisco	2.15	2.15	2.15	2.15
Boston	1.60*	1.60*	1.60*	1.60*
Minneapolis	1.75	1.75	1.75	1.75
Kansas City	1.50	1.50	1.50	1.50
Denver	2.50	2.50	2.50	2.50
Seattle	3.00	3.00	3.00	3.00
Atlanta	**2.50***	2.00*	**2.50***	2.00*
Cincinnati	1.90*	1.90*	1.90*	1.90*
Los Angeles	**1.40***	1.65*	**1.40***	1.75*
Detroit	2.00*	1.70	2.00*	1.70
Baltimore	2.50	2.50	2.55	2.55
Montreal	1.80*	2.25*	1.50*	2.25*
Philadelphia	2.10	2.10	2.10	2.10
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	3.25*	3.25*	3.25*	3.25*
Birmingham	2.00	2.00	2.00	2.00

* Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plant

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.40	$2.00	$1.30
Steubenville District	1.25	1.30	2.00	1.30
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa.	.....	.....	2.50	.....
Birmingham, Ala.	.80@.90	1.15	2.05	.....
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	**1.80**	**1.80**	.....	**1.75**
Eastern Pa. and Northern N. J.	1.25	1.25	2.50	1.25
Western Pennsylvania	1.25	1.25	2.00	1.25
Longdale and Glen Wilton, Va.	1.25	1.25	2.50	.....
Toledo, Ohio	1.25	1.25	1.50	1.25

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$18.20	$12.00@$13.10	$3.50*	$2.25@2.75*
Chicago	20.00	18.00	.....	**2.25**†
St. Louis	24.00	20.00	.....	15.00‡
Boston	20.00	13.50@14.50	**3.75***	3.00*
Dallas	*18.00*	.....	.....	1.85†
Cincinnati	16.80	**14.30**	.....	13.40‡
San Francisco	22.00	.....	.....	1.60‡
Minneapolis	25.50	**21.00**	**1.60@1.70†** (brown)	1.35†
Denver	24.00	.....	.....	2.70*
Detroit	15.50	**12.50**	.....	16.00†
Seattle, *paper sacks*	24.00	.....	2.80†	.....
Los Angeles	25.00	**18.00**	3.50	**19.50‡**
Baltimore	**24.25**	17.85	2.55†	.....
Montreal	.....	21.00	.....	10.00‡
Atlanta	**22.50**	**13.00**	2.20†	1.50†
New Orleans	24.00	16.00	2.50†	2.00*
Philadelphia	23.00	16.00	.....	.....
Kansas City	17.50	**16.00**	**2.45***	2.10*
Birmingham	22.50	16.00	2.40†	1.85†

* Per 280-lb. bbl. (net). † Per 180-lb. (net). ‡ Per ton.

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, exclusive of bags:

	Feb. 4	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.35	1.50
Cincinnati (Utica)	1.72	1.72
Boston (Rosendale)	2.65	2.50
St. Louis (Carney)	*2.35*	2.35
Birmingham (Magnolia) pozzolan cement	2.40	2.40

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Feb. 4	One Month Ago	One Year Ago
New York, del. by truck	$2.50@2.70	$2.50@2.70	$2.50@2.60
New York, alongside dock to dealers	2.15	2.15	2.15
Jersey City	2.33	2.33	2.33
Boston	2.40	2.40	2.60
Chicago	2.10	2.10	2.20
Pittsburgh	2.09	2.09	2.19
Cleveland	2.29	2.29	2.39
Detroit	2.15	2.15	2.35
Indianapolis	2.29	2.29	2.41
Milwaukee	2.25	2.25	2.35
Duluth	2.09	2.09	2.19
Peoria	2.27	2.27	2.37
Cedar Rapids	2.34	2.34	2.44
Davenport	2.29	2.29	2.39
St. Louis	2.20	2.20	2.30
San Francisco	2.31	2.31	2.61
New Orleans	2.40	2.40	2.40
Minneapolis	2.32	2.32	2.42
Denver	2.84	2.84	2.84
Seattle	2.65	2.65	2.65
Dallas	2.05	2.05	2.05
Atlanta	2.35	2.30	2.35
Cincinnati	2.37	2.37	2.47
Los Angeles	2.52	2.52	2.80
Baltimore	2.50	2.50	2.90
Birmingham	2.40	2.40	2.40
Kansas City, Mo	*2.02*	2.40	2.30
Montreal	1.80	1.80	1.80
Philadelphia	2.60	2.60	2.41
St. Paul	2.32	2.32	2.42
Toledo	2.20	2.20	2.40

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind.	$1.85	Hudson, N. Y.	$2.05
Universal, Pa.	1.85	Leeds, Ala.	1.95
Steelton, Minn.	1.90	Hannibal, Mo.	1.95
Fordwick, Va.	2.05	Lehigh Valley District	1.95
Mitchell, Ind.	1.95	Wyandotte, Mich.	1.90
Iola, Kan.	1.85	Alpena, Mich.	1.75
Mason City, Ia.	1.90	Richard City, Tenn.	2.05
La Salle, Ill.	1.95	Kingsport, Tenn.	2.05

E. N.-R. Prices of Construction Materials

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago District Mill	Warehouse: New York	Warehouse: St. Louis	Warehouse: Dallas	Warehouse: San Francisco
032	22	$0.97	$1.01	$1.39	$1.06	$1.13	$1.22
049	28	1.23	1.29	1.76	1.35	1.38	1.55
068	35	1.51	1.58	2.16	1 66	1.67	1.91
093	45	1.94	2.03	2.77	2.13	2.00	2 46
126	57	2.39	2.51	3.45	2.63	2.55	3.03
153	68	2.86	2.99	4.11	3.14	3.15	.....
180	78	3.28	3.43	5.70	3.60	3.47	.....
245	103	4.33	4.53	6.21	4.75	4.58	.....
287	119	5.00	5.24	7.19	5.50	5.26	6.35
336	138	5.80	6.07	8.35	6.37	6.11	.....
395	160	6.72	7.04	9.65	7.38	7.12	.....
PAVING							
036P	17	$0.74	$0.77	$1.06	$0.81	$0.76	.....
053P	24	1.04	1.09	1.50	1.14	1.07	.....
072P	31	1.32	1.38	1.90	1.45	1.39	.....
097P	40	1.70	1.78	2.45	1.87	1.90	.....
049R	24	1.04	1.09	....	1.14	1.07	.....
067R	31	1.32	1.38	....	1.45	1.39	.....
089R	40	1.70	1.78	....	1.87	1.90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq.ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted:

Weight in pounds	New York	Birmingham	Chicago	St. Louis	San Francisco	Dallas
2.2	$19.00	$22.00	$19.00	$19.00	*$19.00*	$23.50
2.5	21.00	23.00	21.00	21.00	*21.00*	25.00
3.0	24.00	26.00	24.00	24.50	*23.50*	28.50
3.4	26.00	28.00	26.00	26.50	*25.50*	31.00

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger..	$2 00	$2.25	$3.24	$3.00	$3.15	$3.38	*$3.10*
⅝.....	2 10	2.35	3.34	3.10	3.25	3.43	*3.20*
¾.....	2 20	2.45	3.44	3.20	3.35	3.48	*3.30*
⅞.....	2 40	2.65	3.64	3.40	3.55	3.63	*3.50*
1.....	3.00	3.25	4.24	4.00	4.15	3.78	*4.10*

For standard classification of extras for size and cutting of steel bars, see bar card of July 15, 1923.

ROLLED FROM RAILS

	St. Louis	Dallas		St. Louis	Dallas
½ and larger.....	$2.55	$2.80	⅝.....	$3.05	$3.02
¾ in.....	*2.65*	2.85	1.....	3.55	3.50
⅝.....	*2.75*	2.90	.....	....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Feb. 4	Common: One Month Ago	Common: One Year Ago	Paving Block: 3-inch*	Paving Block: 3½-inch*
New York (del.).....	$20.40	$18.50	$18.00	$45.00	$51.00
New York (at dock)..	17.25	15.25	15.00	.....	.....
Chicago.....	12.00	12.00	12.00	42.00	45.00
St. Louis, salmon (del.)	16.00	16.00	16.00	40.00	42.50
Denver, salmon.....	12.00	12.00	12.00	.....	.....
Dallas.....	*10.50*	11.10	11.60	35.00	.....
San Francisco.....	15.50	15.50	15.50	.....	.....
Los Angeles.....	11.50	11.50	13.00	(not used)	
Boston (del.).....	17.50	17.50	19.00	45.00	*50.00*
Minneapolis (del.).....	13.50	13.50	15.00	.....	.....
Kansas City.....	*14.50*	16.50	14.50	(no market)	
Seattle.....	15.00	15.00	14.50	.....	42.50
Cincinnati.....	17.00	17.00	17.00	40.00	45.00
Montreal.....	17.50	17.50	17.50	100.00†	60.00
Detroit (del.).....	16.00	16.00	17.50	37.50	40.50
Baltimore.....	18.00	18.00	18.00	40.00	45.00
Atlanta.....	10.50	10.50	10.50	40.00	.....
New Orleans.....	15.00	15.00	15.00	.....	.....
Birmingham.....	12.50	12.50	12.50	40.00	45.00
Philadelphia.....	17@20	17@20	19.00	40.00	50.00
Pittsburgh (del.).....	16.00	16.00	16.00	.....	.....
Cleveland.....	14.00	14.00	14@16	.....	.....

*For paving blocks 3x8½x4 and 3½x8½x4 respectively. †Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Feb. 4 on Trucks*†	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco†	Perth Amboy N. J., Factory*
4x12x12...	$0.1112	$0.1162	$0.075	$0.12	$0.07	$0.108	.....
6x12x12...	.1167	.1743	.096	....	.09¼	.156	.....
8x12x12...	.2084	.2179	.135	.22	.128	.244	.....
10x12x12...	.....	.....	.167	.....	.155	.....	$0.252
12x12x12...	.....	.....	.215	.....	.185	.....	.312

*5 per cent off for cash. †Partition tile.

	4x12x12	8x12x12	12x12x12
Boston.....	$0.085	$0.17	.....
Minneapolis (f.o.b. cars).....	.0636	.106	$0.189
Minneapolis (delivered).....	.07	.116	.205
Cincinnati.....	.07485	.13745	.....
Kansas City.....	.086	.11	.145
Denver.....	.075	.155	.188
Seattle (delivered).....	.10	.20	.30
Los Angeles.....	.085	.172	.....
New Orleans.....	.13	.20	.....
Detroit (delivered).....	.095	.165	.2821
Montreal.....	.12	.....	.....
Baltimore.....	.125	.27	.....
Atlanta.....	.0977	.1837	.....
Dallas.....	.10	.19	.275
Birmingham.....	.11	.1824	.225
Pittsburgh (delivered).....	.068	.128	.179
Cleveland.....	.07	.149	.....

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at place named:

	Pittsburgh Mill	Birmingham	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in....	$1.90@2.00	$2.05	$3.34	$4.15	$3.25	$3.10	$3.30
Channels, 3 to 15 in.	1.90@2.00	2.10	3.34	4.15	3.25	3.10	3.30
Angles, 3 to 16 in., ¼ in. thick.....	1.90@2.00	2.10	3.34	4.15	3.25	3.10	3.30
Tees, 3 in. and larger	1.90@2.00	2.10	3.34	4.15	3.35	3.10	3.30
Plates, ¼ in. thick and heavier.....	1.60@*1.90*	2.00	3.34	4.15	3.25	3.10	3.30

RIVETS—The following quotations are per 100 lb.:.

STRUCTURAL

	Pittsburgh Mill	Warehouse: New York, Feb. 4	Warehouse: New York, One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
¾ in.....	$2.60	$4.50	$4.25	$3.50	$3.65	$5.00	$4.75
CONE HEAD BOILER							
½ in.....	2.90	$4.70	$4.35	$3.70	$4.20	$5.20	$5.00
⅝ and ¾.....	3.05	4.85	4.50	3.80	4.45	5.35	5.15
⅞ and ⅞.....	3.30	5.10	4.75	4.05	4.60	5.60	5.50

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Birmingham	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.....	$2 65	$2.85	$3.15	$3.40	$4.25	$2.93	$4.95
Cut.....	2.80	2.90	....	5.30	5.00	3.15	5.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco: Galv.	San Francisco: Black	Seattle Black
½.....	$7.50	$5.75	$7.75
⅝.....	7.05	5.30	5.65
¾.....	6.90	5.15	5.50

Pittsburgh base in lots of 200 kegs or more, $3.25.

PREPARED ROOFINGS—Slate-surfaced roofing in rolls of 108 sq.ft. costs $2.35@$2.50 per roll to contractors in carload lots f.o.b. New York.

Single shingles, slate finish, cost $7.00 per square (sufficient to cover 100 sq.ft.) in carload lots, f.o.b. New York. Strip shingles (4 in 1) f.o.b. New York, in carload lots to contractors, $5.00 per square.

ROOFING MATERIALS—Prices f.o.b. New York, to contractors in carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton.....	$70.00
Asphalt roofing (in barrels) per ton	25.00
Asphalt felt, per ton.....	72.00

WINDOW GLASS—United inches, 25, bracket size 6x8 to 10x15, single thickness "AA," 83 per cent; "A," 87 per cent; "B," 89 per cent. Double thickness "AA," 82 per cent; "A," 86 per cent; "B," 89 per cent discount from jobbers list at New York warehouses.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10.....	$2.50	$3.60	$3.50	*$3.75*	$3.89
No. 12.....	2.55	3.65	3.55	*3.80*	3.94
No. 14.....	2.60	3.70	3.60	*3.85*	3.99
No. 16.....	2.70	3.80	3.70	*3.95*	4.09
Black					
*Nos. 18 to 20.....	3.15	4.40	3.90	*4.55*	4.30
*Nos. 22 to 24.....	3.20	4.45	3.95	*4.60*	4.35
*Nos. 26 and 27.....	3.25	4.50	4.00	4.70	4.40
*No. 28.....	3.35	4.60	4.10	4.80	4.50
Galvanized					
No. 10.....	3.60	4.70	4.25	5.00	4.50
Nos. 12 to 14.....	3.70	4.80	4.35	5.10	4.60
No. 16.....	3.85	....	4.50	5.25	4.75
Nos. 18 to 20.....	4 00	5.10	4.65	5.40	4.90
Nos. 22 to 24.....	4.15	5.25	4.80	5.55	5.05
*Nos. 26 and 27.....	4.30	5.40	4.95	5.70	5.20
*No. 28.....	4.60	5.70	5.25	6.00	5.50

* For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Feb. 4	New York: One Year Ago	Chicago: Feb. 4	Chicago: One Year Ago
Raw in barrels (5 bbl. lots)....	*$0.88½*	$1.26	*$0.90*	$0.94

E. N.-R. Prices of Construction Materials

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b. New York:

	Dry		In Oil	
	Feb. 4	1 Yr. Ago	Feb. 4	1 Yr. Ago
Red	$15.25	$16.25	$16.75	$17.75
White	15.25	16.25	15.25	16.25

Lumber

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$26.00	$27.00	$28.00	$31.00
3x6 and 8	26.00	27.00	28.00	31.00
4x4-6 and 8	26.00	27.00	28.00	31.00
3x10 and 12	26.00	27.00	28.00	31.00
3x14	30.00	30.00	32.00	34.00
4x10 and 12	26.00	27.00	28.00	31.00
4x14	30.00	30.00	32.00	34.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$28.00	$30.00	$32.00
6x14	34.00	36.00	38.00
8x10	28.00	30.00	32.00
8x14	34.00	36.00	38.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York		Chicago	
	20 Ft. and Under	22-24 Ft.	20 Ft. and Under	22-24 Ft.
3x4 to 8x8	$47.00	48.00	$42.00	$43.00
3x10 to 10x10	52.00	53.00	47.50	48.50
3x12 to 12x12	57.00	58.00	57.50	58.50
3x14 to 14x14	61.00	62.00	**68.50**	**69.50**
3x16 to 16x16	67.00	68.00	75.50	76.50

New York—Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5@$10 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 32 ft. for sizes 12x12 and under; for sizes over 12x12 add $2; for merchantable add $2 to sizes 10x10 and under.

Other Cities

	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir*	Hemlock	Spruce	P.	Fir*
Boston	$51.00	$48.00†	$51.00	$50.00	$61.00	$58.00†
Seattle	.....	23.00	.....	.....	.....	25.00
New Orleans	*37.00*	.....	.....	.....	**45.00**	.....
Baltimore	32.50	49.25	53.00	60.00	38.00	49.75
Cincinnati	37.00	73.00	73.00	85.00	48.00	77.00
Montreal	50.00	58.00	.....	.....	60.00	65.00
Los Angeles	.....	37.00	.....	.....	.....	38.00
Denver	.....	32.75	33.75	33.75	.....	49.50
Minneapolis	42.00	37.75	35.00	.....	44.50	37.75
Atlanta	31.00	.....	.....	.....	34.00	.....
Dallas	**56.00**	.....	.....	.....	56.00	.....
Kansas City, Mo.	44.50	40.75	.....	.....	59.50	*41.00*
Birmingham	32.00	.....	.....	.....	34.00	.....
Philadelphia	*54.00*	34.00	37.00	43.00	65.00	34.00
Detroit	**47.75**	*46.75*	.....	.....	**61.75**	*46.75*
St. Louis	**42.00**	.....	.....	.....	**54.00**	.....

	1-In. Rough, 10 In. x 16 Ft and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir*	Hemlock	P.	Fir*
Boston	$46.00	$42.00†	$45.00	$51.00	$48.00†
Seattle	.....	20.00	.....	.....	22.00
New Orleans	*75.00*	.....	.....	40.00	.....
Baltimore	55.00	44.00	44.00	34.00	50.00
Cincinnati	70.00	79.00	75.00	38.00	85.00
Montreal	56.00	50.00	45.00	45.00	45.00
Los Angeles	.....	37.00	.....	.....	.....
Denver	.....	34.25	29.25	.....	32.25
Minneapolis	42.50	35.75	34.75	38.00	34.25
Atlanta	22.00	.....	.....	28.00	.....
Dallas	52.25	.....	.....	56.00	.....
Kansas City, Mo.	**52.00**	37.75	34.50	*40.00*	.....
Birmingham	20.00	.....	.....	42.00	.....
Philadelphia	34.00	33.00	36.00	52.00	34.00
Detroit	**39.75**	*37.00*	.....	**46.50**	*41.25*
St. Louis	*41.00*	.....	.....	**36.00**	.....

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M. ft. to contractors.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers price to contractors on large projects.
St. Louis—Wholesale price to contractors, f.o.b. cars, $2 per M.ft. additional.
Seattle—Price to contractors, delivered.
Dallas—Wholesale to contractors, $10 per M.ft. additional.
*Douglas fir. †Prime.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

Miscellaneous

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Feb. 4	One Month Ago	One Year Ago
$2.25@2.30	$2.30	$2.05@2.15

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington: Discount 5 points less than discount for Eastern territory.
Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.
Arizona: Discount 10 points less than discount for Eastern territory.
Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.
North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¾-in., 8 ft.; ¾-in., 6; ⅞-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0.19@.25	New Orleans	$0.25½
New York	.27	Los Angeles	.25
Chicago	.25½	Seattle	.24
Minneapolis	.27½	St. Louis	.25½
San Francisco	.25	Montreal	.16
Atlanta	.27	Detroit	.26
Denver	.27	Baltimore	.18
Cincinnati	.21	Kansas City	.28
Dallas	.31	Birmingham	*.28@.29*
Philadelphia	*.26*		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	*$0.265**	*$0.2875*
Boston	.225	.25
Kansas City	.2025	.2225
Seattle	.165	.19
Chicago	*.215**	*.2375**
Minneapolis	.1917	.2123
St. Louis	.2275	.2525
Denver	.2025	.2275
Dallas	.225	.302
Los Angeles	.1875	.2125
Atlanta	.215	.24
Baltimore	.22	.23
Cincinnati	.22	.245
Montreal	.195	.235
Birmingham	*.22*	*.24*
New Orleans	.233	.26
San Francisco	.1625	.1925
Philadelphia	.215	.24

*Special gelatan.

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f.o.b. works:

Sulphate of aluminum, in bags, per 100 lb	*$1.35*
Sulphate of copper, in bbl., per 100 lb	4.50@4.62½
Soda ash, 58%, in bags, per 100 lb	1.38
Chlorine, liquid, tanks, per lb	.04
Hypochlorite of lime (bleaching powder) in drums, per 100 lb	*1.90*

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Atlanta	$0.58	Detroit	$0.29
Baltimore	.31	Kansas City	.735
Birmingham	.58	New Orleans	.67
Boston	.365	New York	.34
Buffalo	.265	Pacific Coast (all rail)	1.15*
Chicago	.34	Philadelphia	.32
Cincinnati	.29	St. Louis	.43
Cleveland	.19	St. Paul	.60
Denver	1.15*		

* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.